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The Geological Column

Cutting through the complexities

The Double Revelation

Nature, Science and the Bible

Noah's Ark comes to rest in Court

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COVER PHOTOGRAPH

Grypæa arcuata from the Lower Lias (Jurassic) muds exposed at Hock Cliff, Fretherne in Gloucestershire. The oyster was suited to the environment in which it is fossilised, the highly curved lower valve being designed to keep the upper valve clear of the muddy substrate. The shell on the left is preserved in the life position. The length of the exhumed shell is 6cm. *(Photograph by Steven J. Robinson.)*

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Editorial

WE ARE sometimes challenged as to why we allow controversy among creationists in our journal. We should be united, attacking only those who teach an evolutionary origin of the universe, earth and life. This is an opinion with which we have a great deal of sympathy.

We had a little correspondence over a recent editorial in which we urged creationist friends to avoid using fallacious arguments. It was felt that we were attacking the integrity of fellow workers who used these arguments. Be it far from us, of course. Rather, we must be united in seeking and teaching the truth. I am sure we all agree on that. We dishonour our God if we use invalid (and, therefore, unscriptural) reasoning.

Similarly, those who read the various creationist journals will be aware of the debate going on regarding the geological column. In spite of former, well-meaning arguments to the contrary, an increasing number of creationist geologists agree that the column is a real phenomenon. There is some debate over where in the column we can identify the beginning and the end of the Flood. The European geologists have been active in this field for many years and others in the States and Australia have joined in the quest. A united resolution has not yet been found. Indeed, each group is gradually modifying their position as they research the subject. However, it has been possible to issue a joint statement, printed in *Origins 22*. Based on this, the different groups are collaborating.

It is often difficult for non-scientists to appreciate how the scientist carries out his or her research. Theories are developed in the light of the facts. They are published and debated. As a result of discussion and argument, these will be modified. Disagreement does not necessarily mean disharmony. It is the process of searching for the truth. It is in this light we have published our work on geology. In this issue, Steven Robinson demonstrates the basic issue underlying the Geological Statement in the last issue. Because it is a subject that is not well known, these articles have tended to be unusually long (for *Origins*). We don't anticipate such long articles in the future, certainly not as the norm! But we trust they are helpful in content.

Several key points are made by Steven. He warns against focussing on local data at the expense of the global (p.20). We believe in a global Flood and so global features. However, he warns against correlations based solely on biostratigraphic criteria (p.23).

Future articles are planned on dinosaurs and trilobites. Further papers will look at the history of creationist thinking and the theological implications of the subject. These are clearly important subjects. We need to remind people that science belongs to Christianity. It was biblical thinking that led to the modern scientific process. There is a general misunderstanding of the historical relationship. We are glad, therefore, to print the second instalment of David Tyler's historical analysis. But, what is the nature of the relationship? Do we reinterpret the Bible in the light of current scientific thinking (as theistic evolutionists suggest)? It is a matter of authority, of course: man's thinking or God's revelation as the primary source of authority. But, how do we check our understanding in these two fields? Robert Bradshaw presents a helpful study of this subject.

As I write this editorial, I have been watching the passing of the Hale-Bopp comet. This has been a stunning sight which fills one with worship and awe. For many of us, there will be questions about its origin and significance in biblical history. I have, on the other hand, been disturbed by some of the unbiblical speculation by Christians, in which they have been trying to link it back to Noah's Flood and others to the Bethlehem Star. Then they extrapolate on to the end of the age, predicting the Lord's return—even suggesting dates. Creationists seek to stand by what the Scriptures say. The Bible says clearly that we cannot know the time of His return nor should we try and predict it.

These are days when many are preparing for the millenium and spending vast sums of money on it. How few are preparing for His return—which may occur before the millenium! And, whose millenium is it anyway?

May God help us to think clearly and biblically, to write and speak truthfully and sensitively.

J.H.J.P.

Apology to readers

In the process of printing *Origins 22*, a line of text was omitted from Figure 10 of Michael Garton's article, 'A Spanish Weekend.' The lower red box should have read 'Fossil dinosaur & bird tracks.'

In the same article, we inadvertently omitted to acknowledge the contribution of Steven Robinson in providing figures 1 and 16. Our apologies to him.

In the last equation on page 25, please note that the plus sign (+) should be a minus sign (–).

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The 'Double Revelation' Approach to Knowledge:

Aquinas, Galileo and Descartes

David J. Tyler

THE HISTORY of science provides numerous examples of scholars in the Christian tradition who have sought to clarify the relationship between science and faith. Very early in this process, people were found advocating what is now called the 'Double Revelation' or 'Two Books' approach.

The basic idea is that God has provided two revelations of Himself: one revelation displays Him as a personal Provider, Redeemer and Lord (the Scriptures); the other revelation displays Him as the sovereign, wise, creator God (the book of nature).

The basic idea is not difficult to understand, and there are biblical texts which are obviously relevant (for example, Psalm 19). Some of the references that have been made to the 'two books' are non-controversial, as they are made in this biblical sense. However, there has been a dominant teaching which is philosophical rather than biblical in character. According to this teaching, these two books are said to be complementary and it is claimed that they do not conflict because they relate to different domains of knowledge.

This article is written in the conviction that the 'double revelation' approach is not helpful, that it actually leads to confusion and that it promotes error. The unity of revelation is undermined when people insist on the mutual independence of the two books. The principle of the sufficiency of Scripture is threatened, because it can appear that the Bible has nothing to say about large areas of life (that is, our whole relationship to and attitude towards the natural world). The approach can hide areas where the study of nature leads to conclusions which are at variance with the study of the Bible (for example, the concept of purpose in creation and the recognition of intelligent design). It contributes to the myth that science and other scholarly activities can be truly objective. In summary, the approach results in a secularisation of thought and a new form of idolatry.

Historically, the double revelation approach has been of some importance in the development of science. There have been two notable controversies which have been inextricably linked with it. These are the Copernican cosmology (with Galileo, for example, making use of the two books argument); and the Darwinian explanation of origins (with the two books argument coming from, for example, the theologian Farrar). There are many today who consider the double revelation approach to be an essential ingredient for any scholarly work by Christians. Thus, Forster and Marston (1989) say that this strategy 'has shaped the whole of Christian and scientific thinking on relationships of science and theology' (p.268). They advocate a policy of following in this well-established tradition. One of the objectives of this essay is to assess the implications of this approach and to consider its relevance for today.

The Roots of the Problem

The double revelation theory can be traced back into a period when Christianity was the state religion. Whenever such a thing happens, it is always a dangerous time for Christians—because Christianity is fundamentally a 'minority' culture. Jesus said, 'My kingdom is not of this world,' and that 'few' are on the narrow road. History is far from silent about the many evils which have entered the church when the state develops a sacral culture and becomes 'Christendom': there is a form of religion but there is no power.

During the Middle Ages, theologians became the academic leaders of the community. The highest forms of knowledge were related to the teachings and practice of the State Church. All other disciplines were perceived as less honourable or as 'handmaidens of theology.' In this way, the study of the natural world (which we now give the name 'science') was justified: it provided 'illustrations' related to theology, so that by them God might be glorified (Grant, 1986, p.50).

However, this 'handmaiden' status did not take science very far. By and large, people did not give serious attention to developing scientific methodology, nor were they excited by the prospect of advancing understanding of the natural world. Why was this so? Was there a tendency to treat the world as 'evil'? Was it regarded as a domain that was going to be 'burnt up'? Responses to these questions are inevitably speculative. Monasticism and asceticism were very strong—and perhaps many potential scientists spent their lives in monasteries. An analogy can be drawn with the Greek scholars, who so elevated their system of philosophy and logic that progress in science was stifled (Tyler, 1996).

This situation continued until the 12th Century: static and languid. The intellectual vacuum led, for some, to a sense of disgust at the intellectual leadership of the time. For example, William of Conches denounced those who showed all the signs of obscurantism. They were:

> 'ignorant themselves of the forces of nature and wanting to have company in their ignorance ... they don't want people to look into anything; they want us to believe like peasants and not to ask the reason behind things' (quoted in Grant, 1986, p.51).

The change occurred when Greek natural philosophy and science became more widely known, initially in its Platonic and Neo-Platonic forms. By the 13th Century, however, Aristotelian philosophy was dominant. The impact of these Greek ideas was to create a new emphasis on rational enquiry. The handmaiden status of science began to change because it began to influence the way the Bible was understood (particularly Genesis 1). Theologians began to feel threatened and the need to address the relationship between biblical revelation and the study of the natural world became more pressing.

Aristotle's philosophy made an extraordinary impact. His writings were considered to surpass those of Plato and the other Greeks in terms of depth and diversity of interests. People read him on physics, metaphysics, logic, cosmology, the elements, epistemology and the nature of change. He extended their minds and excited their imagination.

Significantly, these years saw the emergence of the universities as centres of intellectual activity. The staff of these institutions did not perceive themselves as being just a different kind of seminary—rather, they had their own independent identity. Theology was accepted as the most important faculty, but the theologians were not allowed to control the other faculties. The writings of Aristotle gripped these scholars: there had been an intellectual vacuum in most disciplines which nothing else seemed to fill. As a result, Aristotelianism became the entrenched orthodoxy in universities from 1200 A.D. until the middle of the 17th century.

There was no question that Aristotle was a pagan Greek philosopher and that his approach was in tension with that of the Church scholars. This situation had to be addressed. It came to a head first in the early part of the 13th Century in the University of Paris, where some theologians and nearly all the arts masters converted to Aristotelianism. This made the more traditional theologians (who constituted the majority) very uneasy. The result was a ban on Aristotle's books relating to natural phenomena in 1210 and 1215, and an attempt to expurgate them in 1231. Despite rearguard efforts like this, Aristotle's philosophy became, in time, the core of the curriculum, leaving a large number of traditionally-minded theologians convinced that things were being taught which were subversive to the faith.

Aquinas's Synthesis of Aristotelian Philosophy and Catholic Theology

Enter Thomas Aquinas (1225–1274), who saw Aristotle as the greatest of human philosophers: someone who had achieved the highest level of human thought without the aid of revelation. Aquinas proposed a way of incorporating the essence of Aristotle into the Christian intellectual tradition. He did it by arguing that the world of nature could be known separately from the world of the spirit. The sacred could be distinguished from the secular. Using more contemporary terminology, Aquinas compartmentalised knowledge.

Sacred	Church: grace
Secular	Aristotle: nature

This, in my view, is where the 'double revelation' approach was first articulated in any substantial way. It should be acknowledged that one can find hints of earlier tendencies to think in this way: Jones (1991) gives Tertullian as an example. To summarise the argument again: There is a book of nature which can be read separately from the book of the Spirit. These books belong to two distinct domains of knowledge and are largely independent of each other.

The deficiencies in this scheme, from a biblical perspective, are pointed out by Hooykaas (1972):

> 'Now the idea of a divine creator implies the absolute dependence of the created things on him and also their total differentiation from him. The opinion prevailing amongst the Christian philosophers of the Middle Ages, however, was not wholly consistent with this conception. Nature was considered as a semi-independent power, and when things happened according to nature, this meant that they followed a pattern that seemed rational to the human mind, one which had been discovered by Aristotle. ... In the Middle Ages, then, the biblical view was only superimposed on, and did not overcome, the Aristotelian conception. The regular order of nature was considered to be something instituted by God, but liable to be overruled by Him in a *super*-natural way (the term is significant) when performing a miracle. Thomas Aquinas considered one of the useful functions of natural philosophy to be to enable us to distinguish that which belongs only to God (for example, miracles, or the origin of things) from that which belongs to nature. The Bible, however, attributes all events, however insignificant, immediately to God.' (pp.12–13)

Although not presented in the same context, Schaeffer's books *Escape from reason* and *The God who is there* have drawn attention to Aquinas's legacy to succeeding generations in philosophy and many other disciplines of knowledge. He refers to 'the teaching of a man who changed the world in a very real way.' Obviously, much more could be said, but not in this essay. Schaeffer's helpful studies are recommended as general follow-up material.

It must be noted that Aquinas's synthesis was not accepted immediately. Many traditional theologians continued to speak about the subversive character of Aristotelianism. The Bishop of Paris, Elienne Tempier, responded in 1270 with a condemnation of 13 propositions and in 1277 by a condemnation of 219 propositions—threatening excommunication to the transgressors. The propositions were collated from many sources and lacked coherence. Some of them were directed against Thomas Aquinas, although these were nullified in 1325. In the Paris region, the condemnation was enforced throughout the 14th Century.

One of the key areas for Tempier's concern related to the conflict between Aquinas's acceptance of the principle of logical necessity (nature *has* to be like this) and the theological doctrine of the sovereignty of God. The theologians wanted to preserve the absolute power of God to do as He pleases. Although the way they chose to do this cannot be defended, the desire to assert God's sovereign control over against Aristotelian logical necessity must be considered a step in the right direction.

However, did these theologians ask interesting questions like 'What if God chose to create the world so that it spun on its own axis and moved around the sun?', or 'What if God's world were created in a way that objects continue to move unless a force causes them to stop?'? No, they did not! Questions like this might have challenged Aristotle's natural philosophy. Instead, the theologians posed questions like: 'Could God have created other worlds?', 'Could two angels occupy the same point of space?', and 'Could an angel occupy two places simultaneously?' The theologians developed a range of thought experiments like these to explore a number of ideas outside the topics covered within Aristotelianism. It has been suggested that this 'generated some of the most daring and exciting scientific discussions of the Middle Ages' (Grant, 1986, p.69). However, I am not convinced of this. Certainly these scholars were breaking out of the Aristotelian mould, but I hesitate to link their thought experiments to scientific activity. The discussions were entirely speculative and bore no scientific fruit. No scientific methodology is in evidence: there is no testing of ideas and no attempt to relate speculation to the evidences of the real world.

Despite the proposals of Aquinas, a real unification of knowledge was not achieved. Aristotle's methodology was inherently rationalistic and closed to all thoughts of revealed truth, so it could only be adopted when theological issues were avoided. This truce was the pragmatic solution to the impasse.

> 'Arts masters were free to uphold almost all of Aristotle's scientific conclusions and principles, provided that they conceded to God the power to create events and phenomena that were contrary to those conclusions and principles and which were therefore naturally impossible in the Aristotelian system. They were thus free to support Aristotle and deny the existence of other worlds if only they would allow that God could create them if he wished.' (Grant, 1986, p.68).

In this way, a barrier was erected. In contemporary language: 'use secular thinking as long as you keep it chained and do not use it to defy the authority of the Church. Keep out of theology, where you have no expertise.' The only people who were permitted to mingle theology and science were the theologians, whose training allowed them to operate in both areas. This situation was doomed to fail—as we have seen in the case of Copernicus (Tyler, 1996). The root problem is that these theologians had no coherent methodology of science, no unified theory of knowledge (based on the Scriptures) and had a corrupted view of Christian theology (having lost touch with the authentic Christian message).

Galileo and the 'Two Books' of Revealed Truth

The double revelation theory became prominent when Copernican astronomy was the subject of discussion. Those scholars who employed the two book argument to defend Copernicanism were keen to emphasise what we might today call 'sphere sovereignty' and quick to complain about people meddling in matters where they had no expertise. Thus Galileo wrote:

> 'Our opinion is that the Scriptures accord perfectly with demonstrated physical truth. But let those theologians who are not astronomers guard against rendering the Scriptures false by trying to interpret against it propositions which might be true and might be proved so' (quoted in Westman, 1986, p.101).

At that time, all were agreed that the book of nature was written by God. They were not of the same mind as to how the book should be read. A methodology was needed. Galileo's response was to refer 'readers of nature' to the language of mathematics.

> 'Philosophy is written in this great book—I mean the universe—which stands continually open to our gaze, but it cannot be understood unless one first studies the language and the characters in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures, without which is it humanly impossible to understand a single word of it.' (quoted in Shea, 1986, p.123).

We ask: why mathematics? The answer is complex—but linked to the philosophy of science held by Galileo. He had rejected much of Aristotle's position—but not his rationalistic scientific realism. He held that there is a physical reality which can be discovered by human powers of reason and observation. This meant that Galileo was a deductivist at heart—and many of his extreme statements (about proofs for Copernicanism, or about the Earth's tides, for example) flow from this confidence in his own conclusions. The belief that nature is mathematical in form links him to several Greeks: Plato and Archimedes in particular.

Reading the book of nature can only be done when the reader recognises and understands the writing. What makes it possible? Galileo had some pagan answers: scientific realism and mathematical rationalism. Thus far, his was not a Christian position. The role of the Scriptures was not even mentioned. Galileo was advocating answers which Christians could not adopt without compromise.

How did Galileo handle the question of the relationship of the two books to each other? He argued that in the natural world there is objectivity and clarity which may not be found by reading the Scripture—which uses words adapted to common understanding. In areas of conflict about natural phenomenon, the revelation obtained from the natural world should be preferred.

> 'I think that in discussing natural problems we should not begin from the authority of scriptural passages, but from sensory experiences and necessary demonstrations; for Holy Scripture and nature proceed alike from the divine Word, the former at the dictate of the Holy Spirit and the latter as the faithful executrix of God's commands. Furthermore, Scripture, adapting itself to the understanding of the common man, is wont to say many things that appear to differ from absolute truth as far as the bare meaning of the words is concerned. Nature, on the contrary, is inexorable and immutable; she never transcends the limits of the laws imposed upon her, and she is indifferent whether her secret reasons and ways of operating are understood by men. It would seem, therefore, that nothing physical that sense experience sets before our eyes, or that necessary demonstrations prove to us, should be called in question, not to say condemned, because of biblical passages that have an apparently different meaning. Scriptural statements are not bound by rules as strict as natural events, and God is not less excellently revealed in these events than in the sacred propositions of the Bible.' (quoted in Shea, 1986, p.126).

Galileo acknowledged that reinterpretations should not be made lightly, but only where there was demonstrated conflict. He clearly believed that the geocentric theory was one such case—the proof for heliocentricity was (in his view) overwhelming. He also used the doctrine of accommodation as a way out of the conflict (discussed in Tyler, 1996)—but in his case this made accommodation an expediency, not a better understanding of God's living word!

The view that accommodation is a compromise position may be linked with Galileo, bearing in mind he was a loyal Catholic. Within that community, traditional views were assumed to be right because of the authority of the Catholic Church. Innovation was looked upon with suspicion. If the Pope was the earthly shepherd of the faithful, and if the Church was the guardian of orthodoxy, dissent from any of the Church's teachings tended to be viewed as the result of devious motives and leading to heretical consequences. Galileo was under some pressure to justify his dissenting position, and he needed robust arguments to stand against the traditions of the Church. He used the two books argument to establish science as a separate sphere of knowledge—which the theologians could not touch. The thought that the Bible has language accommodated to the erroneous ideas of unlearned peoples enabled him to defend the autonomy he sought.

Galileo strongly believed that the status of Copernicanism was proven, even though in his day it was not possible to decide on observational grounds between the Copernican system or the geocentric system of Tycho (his contemporary). This reflects Galileo's deductive approach to science, his emphasis on a mathematical form to the natural order, and his supreme confidence about the conclusions of science.

Many Christians have regarded Galileo as a role model, but sufficient has been said above to show that numerous cautions are needed. Russell (1985) wrote that it was Galileo:

> 'who perhaps gave the most memorable pointer to a way out of the dilemma [*i.e.* the role of Scripture in settling questions of scientific belief]. It was to recognise a distinction between the kinds of knowledge obtainable from nature and from Scripture. He said (probably echoing one Cardinal Baronicus) that in giving us the Scriptures: "The intent of the Holy Ghost is to teach us how one goes to heaven, not how heaven goes." ' (p.47).

The crucial question is whether this 'pointer' is a principle of interpretation which is recognised and supported by Scripture itself, or whether the principle is imposed upon Scripture as a way out of a dilemma.

Descartes's Alternative to Aristotelianism

A parallel response to the problems created by the popularity of Aristotelianism was provided by Descartes. As time passed, there were plenty of evidences that the traditional orthodoxy was crumbling, and Descartes decided to develop an alternative system based on logic, mathematics and a deductive methodology. He built his philosophy on a belief in God—justifying the validity of reason from the idea that God has given us minds to think. As a committed Roman Catholic, he had to address the relationship between his faith and his proposed philosophy.

Descartes distinguished between two realms: the secular and the spiritual. In the secular realm, it is necessary to start with doubt and to build towards truth using rational principles. There is no input from revelation and nothing can be learned about God from the study of the natural world (*i.e.* there is no 'natural theology'). In the spiritual realm, we receive revelation from God via the Church. There is to be no place for doubt.

This strict division between spiritual and secular was unstable—and many people, such as Isaac Newton, accused Descartes of atheistic thinking. It was the double revelation approach pushed to the limit.

Descartes appears not to have defended himself by appealing to the precedent set by Aquinas. It may be that he developed independently his thinking about the relationship between science and Scripture. This article is not claiming that there is an identifiable historical linkage between the different advocates of the double revelation approach: only that it has been found a very attractive solution to a problem and that these ideas have been remarkably persistent through the centuries from Aquinas up to the present day.

Conclusions and Applications

1. There is a need to clarify reference to God's Two Books of knowledge. There is a biblical truth that God reveals Himself in the natural world as well as revealing Himself through the prophets, the written word, and supremely in Jesus Christ. The controversy about the Two Books approach relates to the relationship between the two

books. The use of such terminology is eminently biblical when it is perceived as a metaphor, emphasising different ways in which God's has revealed himself. But when the meaning hardens into a rigid dogma of two autonomous books, in which science is the autonomous study of nature and theology is the autonomous study of revelation, biblical truth has become twisted into error.

2. Autonomous scholarship. Since the time of Aquinas, there has been an influential compartmentalisation of knowledge, isolating all forms of revealed truth from the study of nature. Scholars adopting the double revelation approach have developed science, philosophy and other branches of scholarly activity in isolation from the Scriptures. This has led to all branches of human scholarship being characterised by autonomy. In this way, the myth has been promoted that science leads to culturally-free, objective knowledge. More recently, because there was nothing robust enough to check it, these seeds that were sown have sprung up and flourished to produce what has become known as positivist science. Such attitudes to the study of nature have the form of idolatry and are an attack on the unity of all knowledge in Christ: the Logos, the Truth. By contrast, Christian scholarship emphasises the unity of all knowledge, and the ultimate harmony of all truth. An indication of how these ideas can be applied may be found in the *Creation Manifesto* (1996).
3. Science and the quest for truth. Aquinas, Galileo, Descartes and others within the Catholic Church struggled with the problems of integrating science within the life of the Church. They all came to a similar conclusion: demarcation was needed. In other words, science must be defined to operate in a domain where it could be 'safe' from the deductive thinking of philosophers or the dogmatic pronouncements of theologians. For them, autonomy in natural philosophy was the way to seek truth. However, the inevitable result of autonomy is bondage! By isolating science from revelation, it effectively isolates itself from effective criticism, and it becomes incapable of resisting the slide towards dogmatism (for example, scientism). In a similar way, theologians who accept the autonomous two books come to face similar difficulties of being immune from critical appraisal. But this is not the only option before us! Outside the 16th Century Catholic Church, the reign of dogma and tradition had been broken by the Reformation. It became possible for theologians in the Reformed churches to reconsider what the Bible did teach (Tyler, 1996). The Protestant attitude of 'always reforming' contrasted totally with the message coming from Catholic leaders, and when people were influenced by this Reformation spirit, their approach to science and the world of nature was much more healthy. With this attitude, we know that our understanding of God's world is deficient and we study nature with an attitude which expects change when our understanding is clarified.

The trends described in this article have related to intellectual struggles within the Roman Catholic Church. The next step is to trace the impact of these ideas within Protestant circles: particularly considering the way modern scientific methodology was developed within Protestant countries. In particular, the contribution of Francis Bacon must be assessed.

Acknowledgements

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David Tyler is the General Secretary of the Biblical Creation Society and a regular contributor to this and other creationist journals.

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The Interpretation of Nature and the Bible

Robert Bradshaw

AS AN OBSERVER of the creation/evolution debate for several years I have noticed two extreme positions being taken over the degree to which our humanity affects our understanding. Some popular presentations of evolution (those by David Attenborough spring to mind) present science as totally objective and clear cut: the 'facts' of science cannot mean anything else other than what the majority of scientists affirm.

The Bible, on the other hand, is a religious book and therefore what it means is a matter of *interpretation*—in other words it can mean anything you want it to mean. Some creationists take the exact opposite view: it is science that is subjective, but the Bible cannot mean anything else than what creationists say it means.

Both extremes have an element of truth in them, but both are misleading. In the following article I will examine some of the issues involved in the interpretation of both the Bible and nature. It is my hope that it will help creationists in particular to better understand the subject of biblical hermeneutics.

The Interpretation of Scripture

It is generally acknowledged that since the beginning of the twentieth century advances in the art and science of interpretation (or hermeneutics as it is known) have greatly enhanced our understanding of the Scriptures.[1] Briefly stated, the purpose of interpretation is to discover what God was saying to the original recipients of Scripture and then apply that in our lives today.[2] It is important to stress that the discovery of the text's intended meaning is not the end of the process, but the beginning. The interpretation of Scripture is not complete until its application is found for the reader in his or her present situation (Osborne, 1991, p.12; Packer, 1983, pp.345–346). Modern hermeneutics follows closely the historical method of exegesis practised by the Antiochenes (Thiselton, 1980, p.115; Dockery, 1991, pp.58–59) such as Theodore of Mopsuestia (*ca.* 350–428), John Chrysostom (374–407). and later by the Reformers Martin Luther and John Calvin (Johnson, 1990, p.11).

In order to discover the text's intended meaning the reader has to recognise the temporal and cultural distance between him or herself and the human writer of Scripture (Thiselton, 1980, p.11). This means that when we come to the text we must recognise that we invariably read into it (consciously or unconsciously) our individual world-view, consisting of our 'background, education, presuppositions, culture, character, needs and desires' (Bromiley, 1979, p.64). These presuppositions are likely to be very different from those of the original readers of, for example, one of Paul's letters. This does not mean that we can never understand the meaning of a text (as some have claimed) because it is possible to bridge the distance between the modern reader and the original audience by means of a consistent hermeneutic.[3] As we read the Scripture and learn more about the situation of the people to whom it was originally addressed, we are changed by it and so our presuppositions change. The process of interaction between reader and text is called the hermeneutical *circle* by many writers. However, it is better described as the hermeneutical *spiral* because by continued interaction with the text the reader 'spirals' nearer and nearer to the author's intended meaning (Thistleton, 1980, pp.104, 439; Packer, 1983, pp.348–349; Osborne, 1991, p.6).

Creationist Professor John Rendle-Short provides an example of the hermeneutical spiral in action. He argues that God could not have used evolution because it states in Genesis that God defined His creation as 'good.' Rendle-Short points out that the presence of cruelty and death inherent in an evolutionary process could never be defined as being 'good.' In effect he is saying that our interpretation of Scripture must be consistent with the character of God.[4] So it follows that in order to check whether your understanding of a biblical text is correct, you must understand the character of God. Everyone has their own idea of what God is like, but the only source of objective information about God's character is the Bible itself. Therefore, as you read the Bible you learn what God is like and have the ultimate standard to judge what 'good' is.

Creationist Suspicion of Hermeneutics

This description of the process of interpretation has been treated with suspicion in some quarters because it appears to undermine the doctrine of infallibility of the Scripture.[5] The problem is caused by a confusion of the infallibility of the text with that of the interpretation. While the Scripture is infallible, our understanding of its meaning (that is, our theology) is not. Only by careful application of the rules of hermeneutics can we reach the true meaning of Scripture. The rejection by some of the Church's historic position that the Bible is authoritative when it mentions issues relating to the natural world owes much to interpretations that were wrongly attributed to Scripture, such as a geocentric cosmology. In that particular case a point of crisis was reached when the accuracy of the official interpretation of Scripture could no longer be upheld. People associated the accuracy of the interpretation with accuracy of Scripture, so both were rejected. Augustine

No.	SUBJECT	INTERPRETER					
		J. Calvin (1992)	H.M. Morris (1976) Whitcomb and Morris (1961)	E.J. Young (1966, 1976)	E.H. Andrews (1986)	David Rosevear (1991)	D.C.C. Watson (1976,1989)
1	Was there death before the Fall?	Yes (human) [127]	No [1976, 127]	?	Yes (animal & vegetable) [82]	No [18]	Yes (Vegetable) [1976, 64–65]
2	God physically formed Adam with his hands (Gen. 2:7)	?	Yes [1976, 87]	No [1976, 68]	?	?	?
3	God physically breathed into Adam (Gen. 2:7)	?	Yes [1976, 85–86]	No [1976, 69]	?	?	?
4	Did God physically plant a garden (Gen. 2:8)?	No [113]	Yes [1976, 87]	?	?	?	?
5	Who walked in the garden with Adam & Eve? (Gen.3:8)	God manifested as wind [161]	The pre-incarnate Christ [1976, 121]	The pre-incarnate Christ [1966, 74]	?	?	?
6	Who were/are the 'offspring of the serpent'? (Gen. 3:15)	?	Evil men [1976, 121]	Evil spirits [1966, 116]; Evil men [1976, 106]	?	?	Snakes [1976, 66]
7	The Bible contains a complete genealogy. (Gen. 5, 11)	Yes [227]	No [1961, 481–483]	?	No [73]	Yes [149–150]	Yes [1989, 93–96]
8	Who were the 'Sons of God' (Gen. 6:1–4)?	Descendants of Cain [237– 239]	Angels [1976, 164–170]	?	?	?	Not angels [Personal communication]

? = No view expressed in writings.

The six writers cited above all have important roles in the modern debate over creationism. John Calvin, the Protestant Reformer, is often cited by modern creationists as an authority. Henry Morris and the late E. J. Young are American creationists and E. H. Andrews, David Rosevear and David C. C. Watson are British creationists. The chart is meant simply to demonstrate that a difference of opinion occurs, not who has (in my view) the right interpretation of particular verses.

Table 1: Disagreements Among Leading Creationists Over Biblical Interpretation

of Hippo (354–430) warned Christians of his day of this danger:

> 'In matters that are obscure and far beyond our vision, even in such as we may find treated in Holy Scripture, different interpretations are sometimes possible without prejudice to the faith we have received. In such a case, we should not rush in headlong and so firmly take our stand on one side that, if further progress in the search for truth justly undermines this position, we too fall with it. That would be to battle not for the teaching of Holy Scripture but for our own, wishing its teaching to conform to ours, whereas we ought to wish ours to conform to that of Sacred Scripture.' (Augustine, 1982, p.39).

Some argue that hermeneutics is unnecessary because of the work of the Holy Spirit in illuminating Scripture to the believer. The variety of interpretations of the Scriptures regarding baptism, the role of women in the ministry and the gifts of the Spirit, all held by equally sincere believers should be sufficient evidence to show that such a theory is flawed. In addition, it often leads to spiritual pride whereby those who have had the 'revelation' of a particular point see themselves as being superior to those who have not.[6] The role of the Holy Spirit in illuminating Scripture is not to replace the rational process of interpretation or to provide us with new information (Thistleton, 1980, pp.90–92). Rather the Holy Spirit helps us to overcome the effects of sin in the rational process and overcome our presuppositions so that we 'remain open to further leading from the Spirit and challenge from our peers.' (Osborne, 1991, p.341).[7] In addition to this role the '... Spirit convinces God's people of the truth of the biblical message and convicts and enables them to live consistently with that truth.' (Klein, *et al.*, 1993).

The subject of hermeneutics is given very little attention in books by creationists. Henry M. Morris rejects the need for a hermeneutic and implies that those who practice it are of doubtful orthodoxy when he writes:

> 'We do not question that God 'speaks' through His creation, but such natural revelation must never be considered equal in clarity or authority to His written revelation, especially as it is often 'interpreted' by fallible human scholars, many of whom do not even believe the Bible. The Scriptures, in fact, do not need to be 'interpreted' at all, for God is well able to say exactly what He means. They need simply to be read as the writer intended them to be read, then believed and obeyed.' (Morris, 1984, p.47).

As I have pointed out already the point of 'interpretation' is to achieve exactly what Henry Morris wants—the correct application of the author's intended meaning. Most creationist writers, like Morris, state that the Genesis account should be interpreted literally (Lubenow, 1992, p.146). Some add that phenomenological language and figures of speech need to be taken into account (Gitt, 1986, p.27) and appeal to the perspicuity of Scripture[8] (the principle that states that the Bible is sufficiently clear for all believers to understand it). However, as Walter C. Kaiser points out, the principle of perspicuity is often misapplied:

> '... this principle may be overextended if it is used as an excuse against further investigation and strenuous study by believers who are not contemporaries of the prophets and apostles who first spoke the word of God. Scripture, in any faithful translation, is sufficiently perspicuous (clear) to show us our sinfulness, the basic facts of the gospel, what we must do if we are to be part of the family of God, and how to live for Christ. This does not mean, however, that in seeing (and even understanding) these truths we have exhausted the teaching of Scripture. Neither does it imply that the solution to every difficult question in Scripture or life is simple, much less simplistic. It only affirms that, despite the difficulties we find in Scripture, there is more than enough that is plainly taught to keep all believers well nourished.' (Kaiser, 1980, p.128).

In one of the better treatments of hermeneutics by a creationist, Professor E. H. Andrews notes the importance of literary genre, figurative language and the priority of the author's intended meaning (Andrews, 1986, pp.80–86). However, he goes on to imply that it is only theistic evolutionists who approach the text with presuppositions that differ from those of the text's author (Andrews, 1986, p.86). The fact that equally sincere creationists can still produce totally different 'literal' meanings from the same text indicates that interpreting the Bible is not as easy as some suggest. Table 1 shows the variety of interpretations made by creationists of key verses in the early chapters of Genesis. Marvin Lubenow draws attention to the abuse of hermeneutics with regard to the Genesis account of creation, but makes no positive comment about the need for a good hermeneutic (Lubenow, 1992, p.239). In contrast John Barton Payne, in an article cited by Lubenow, underlines the dangers of bad interpretation, but made it clear that hermeneutics 'is in fact indispensable for proper exegesis and becomes detrimental to biblical truth only when perverted into what Engelder has called "the hermeneutics of the moderns." ' (Payne, 1960, p.93).

As a result of the general suspicion, creationists have not engaged with biblical hermeneutics, leaving theistic evolutionists to dominate the field, something which I for one find extremely worrying. Gordon Fee and Douglas Stuart point out that '[t]he antidote to bad interpretation is not *no* interpretation, but *good* interpretation, based on common-sense guidelines.' (Fee and Stuart, 1993, p.17). The time has come for creationists to realise that the science and art of hermeneutics is not a threat, but actually supports their position. Likewise we all have to realise that we have presuppositions when we read the Bible. The recognition of our presuppositions is essential if we are to allow for them in our exegesis.

In attending creationist seminars I have often been surprised by poor exegesis practised by the speakers. One of the key principles of the Reformers' hermeneutic was that 'Scripture interprets Scripture.' However, this dictum is open to abuse if the exegete relies simply on the use of the same word in two passages and ignores the word's meaning in its context. At one seminar that I attended in 1995, the speaker asked the audience how many days God created, and then answered it by saying that He only created one day, because after the earth was made and turning on its axis no further creative act was necessary to make another day. The speaker then proceeded to 'prove' his point by cross-referencing Genesis 1 with Psalm 118:24: 'This is the *day* that the Lord has made; let us rejoice and be glad in it.' (*NIV*, emphasis mine). He assured his audience that the 'day' mentioned in the Psalm was not the 'day' on which it was being sung, but referred instead to the creation of the first day. The fact is, however, that the day mentioned in Psalm 118 *does* refer to that day of rejoicing on which the Psalm is being sung and not to Genesis 1. Nowhere in the context is there any hint that the author of the Psalm had anything other than this in mind. In order for 'Scripture to interpret Scripture' the cross-references must be alike in the person, object or concept they are describing, not just because they use the same word.

Hermeneutics and The Creation / Evolution Debate

This leads me to make the following points regarding the present creation/evolution debate:

- In recent years creationists have been extremely successful in publicising the scientific evidence for their views. However, this success has not been balanced by a recognition of the science of biblical hermeneutics.

Creationist speakers and writers, who are mostly scientists with little or no theological training need to give more attention to good exegesis and not simply dismiss those who attempt to practice it as 'liberals' when this is clearly not the case.

- Our interpretation of Scripture is significantly affected by our presuppositions. An evolutionary view of Scripture will always have difficulty accommodating biblical statements concerning Adam's position as the first man, the origin of sin and the universality of the Flood. It will also profoundly affect those doctrines which are based upon a historical understanding of Genesis 1–11. Such doctrines include marriage, sexuality and human mortality.
- A knowledge of the history of the way Christians have interpreted Genesis 1–11 enables us to recognise how an interpreter's presuppositions affected what he wrote about Genesis. It is easier, with the benefit of hindsight, to see how Origen's Neoplatonism led inevitably to what he wrote about creation. It is less easy to recognise our own prejudices. Such knowledge also enables us, as Anthony Thistleton notes, to draw upon those 'interpretations and insights that have stood the test of time.' (Thistleton, 1980, p.439).
- The histories of science and of the interpretation of Scripture, together with the principles of hermeneutics all teach us that it is unwise to commit oneself too strongly to a particular 'scientific' interpretation. Examples can be given on both sides of the debate. On the evolutionist side the existence of Nebraska man *(Hesperopithecus haroldcookii)* (Johnson, 1991, pp.5–6) and Piltdown man *(Eoanthropus dawsoni)* (Bowden, 1977, pp.3–55) were for a time accepted as a fact. Creationists, for their part, have in the past pointed to the Paluxy River footprints (and some, regrettably, still do) (Whitcomb and Morris, 1961, pp.166–169; Morris, 1984, pp.353–354).[9] This does not mean that creationists should never make use of scientific data, but rather that they should do so more cautiously.

Having looked at the principles of biblical interpretation, we will now briefly summarise the interpretation of the natural world by modern science. As will become obvious shortly, there is a strong parallel between the two.

The Interpretation of Scientific Data

Up to the 1960's the empirical method of the Baconian understanding of science assumed total objectivity on the part of the scientist. The human failings of the scientist were excluded by strict adherence to inductive logic, which (it was thought) was all that was required to discover the laws of nature. This is the definition of the scientific method that is popularly presented today, and which is reflected in most dictionary references to the word. As science developed it was realised that the inductive method was inadequate when it came to attempting to explain things that involved the unobservable, such as magnetic fields, subatomic particles and the distant past. It was realised that there is no direct link between data and a theory that attempts to account for them. The successor to inductive science, Hypothetico-Deductivism fared no better. This worked by testing the validity of any theory whatever its source according to the results it predicted. If an experiment achieved the predicted results then the theory was assumed to be accurate. Perhaps the most telling criticism of this method was that there are potentially an infinite number of theories that might explain a given set of data. The selection of the most satisfactory theory is therefore determined on the basis of non-empirical factors, which allows an element of subjectivism to enter the process. The principle of falsification also failed as a means of establishing the truth of a theory. In practice it is impossible to be sure whether an experiment failed to provide the result predicted by a theory because the theory was wrong or because of some other reason, such as inadequate equipment. (Ratzsch, 1996, pp.103–115).

In 1962 Thomas Kuhn demonstrated in his book *The Structure of Scientific Revolutions* that the views of science discussed above were untenable. He pointed out that the gathering of data does not lead inevitably to a specific scientific theory to explain it (Kuhn, 1962, p.4). Instead, the world-view of the scientist observing the experiment played a part in the selection of a theory to interpret the evidence. Kuhn proposed that science developed by means of *paradigm* shifts. A *paradigm* can be thought of as a conceptual framework for interpreting information. Once a paradigm, such as Newtonian physics, is accepted by the scientific community, research proceeds to explain new and existing experimental data in terms of the framework provided by the paradigm (a process known as *normal science)* (Kuhn, 1962, pp.35–42). The paradigm focuses research and excludes certain issues from investigation (Kuhn, 1962, pp.24–25). When some item of data does not fit within the paradigm it is called an *anomaly.* Small numbers of anomalies may be ignored by scientists, but if the numbers or seriousness of these grow too large then confidence in the ability of the paradigm to interpret data is shaken. At this point the paradigm reaches what is known as a state of *crisis*, and some scientists will start to seek an alternative paradigm that will explain the anomalies. The process of changing over to the new paradigm is gradual and is always strongly resisted. Kuhn writes:

> 'At the start a new candidate for paradigm may have few supporters, and on occasions the supporters' motives may be suspect. Nevertheless, if they are competent, they will approve it, explore its possibilities, and show what it would be like to belong to the community guided by it. And as that goes on, if the paradigm is one destined to win its fight, the number and strength of the persuasive arguments in its favor will increase. More scientists will then be converted, and the exploration of the new paradigm will go on. Gradually the number of experiments, instruments, articles, and books based upon the paradigm will multiply. Still more men, convinced of the new view's fruitfulness, will adopt the new mode of practising normal science, until at last only

> a few elderly hold-outs remain. And even they, we cannot say, are wrong. Though the historian can always find men—Priestley, for instance—who were unreasonable to resist for as long as they did, he will not find a point at which resistance become illogical or unscientific. At most he may wish to say that the man who continues to resist after his whole profession has been converted has *ipso facto* ceased to be a scientist.' (Kuhn, 1962, p.158)

When the majority of scientists accept the new paradigm, a scientific revolution or paradigm shift is said to have occurred and a period of normal science, in which data is interpreted within the new paradigm, resumes.

Although Kuhn's work was criticised for several reasons, such as his rather vague definition of what exactly a *paradigm* was, his work has profoundly affected the way in which we think about science. Del Ratzsch summarises Kuhn's contribution as follows:

> '... briefly what Kuhn did was to advance the idea that the involvement of things beyond merely the empirical is both inevitable and legitimate in science. We humans cannot even in principle avoid having various of our broad metaphysical and value convictions play some role in our science. Our senses and our reason are not simply detachable from deeper streams that flow within us, so we cannot construct a 'pure' science employing only those detached faculties. This at least suggests the possibility that even political themes, religious themes or other things that deeply shape our being might have some inescapable, perhaps even legitimate role to play in our science and scientific theorizing.' (Ratzsch, 1996, p.119).

Operating Within a Double Hermeneutical Spiral

From the above discussion it is clear that the interpretation of neither nature nor the Bible is as straightforward as either of the two extremes mentioned in the introduction would have us believe. Not only does our view of Scripture influence our understanding of the natural world and *vice versa*, but both understandings are subject to change. Dan G. McCartney accurately summaries the problem we face:

> 'If we are to achieve genuine understanding of God's intent in the Bible, we will have to be continually informing our world view both by general revelation and by special revelation. We thus operate in a double hermeneutical circle. It may be disturbing to some to think of general revelation as in any way informing our understanding of special revelation, but it can hardly be otherwise. If nothing else, our understanding of language and the meaning of words, even the development of concepts such as life, comes about by way of general revelation. We could not even read the Bible without some preunderstanding based on general revelation. Therefore we cannot afford to ignore data from outside the Bible. It too is valid, not by itself, but in relationship to the Bible.' (McCartney, 1988, pp.111–112).

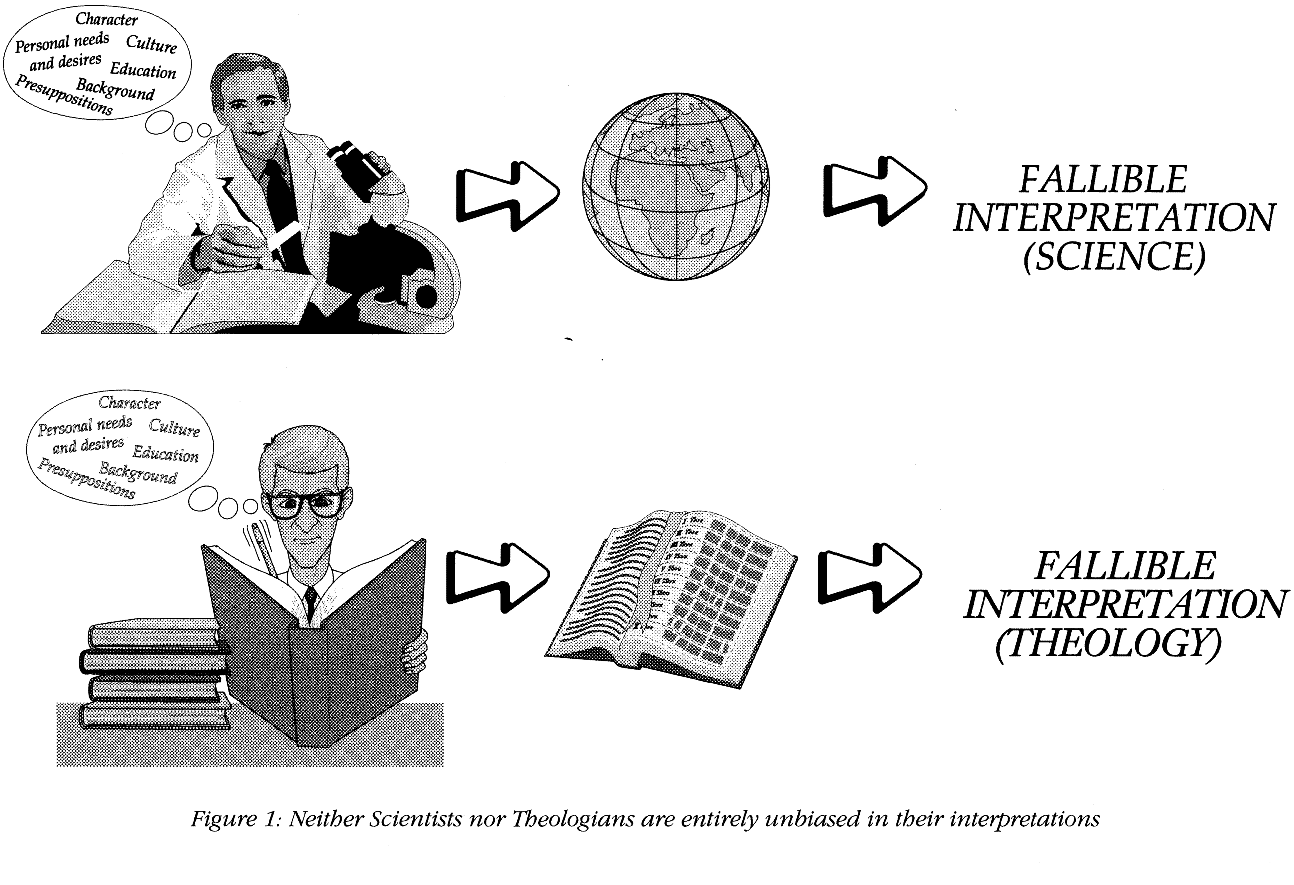
Character
Personal needs and desires
Culture
Education
Background
Presuppositions
FALLIBLE INTERPRETATION (SCIENCE)
Character
Personal needs and desires
Culture
Education
Background
Presuppositions
FALLIBLE INTERPRETATION (THEOLOGY)

Figure 1: Neither Scientists nor Theologians are entirely unbiased in their interpretations

Conclusion

Figure 1 illustrates this 'double hermeneutical spiral' in which we are all involved. Both theologians and scientists would argue that they have good reasons why they think a particular interpretation is correct. Although the principles that a scientist would use are beyond the scope of this paper (See Ratzsch, 1996, pp.120–135), I have attempted to outline some of the more important principles of biblical hermeneutics above. Our response should not, I suggest, be either to say that truth is unknowable or to shoot the messenger by ignoring the principles of hermeneutics. Rather it should be to recognise that we cannot approach any subject without preunderstandings. It is only when we recognise that we have such preunderstandings that we can attempt to correct them. It is my hope that this article will act as a challenge to my fellow creationists to learn about hermeneutics and apply its principles. If we fail to respond to the challenge then more and more books by theistic evolutionists will point out the inconsistencies in our interpretations in their attempt to discredit our views.[10] I would like to leave the last word to Walter C. Kaiser, who points out the importance of the issues we have been looking at:

> '... the basic teaching of all of sacred theology is inseparably connected with the results of our hermeneutics; for what is that theology except what Scripture teaches? And the way to ascertain what Scripture teaches is to apply the rules and principles of interpretation. Therefore it is imperative that these rules be properly grounded and that their application be skillfully and faithfully applied. If the foundation itself is conjecture, imagination, or error, what more can be hoped for what is built on it?' (Kaiser, 1980, p.119).

Notes

1. See further on the changes in the understanding of the Bible: Barr, 1961; Thiselton, 1980; Silva, 1983; Klein *et al.*, 1993.
2. Augustine of Hippo also used this definition. See Augustine, 1982.
3. Such a hermeneutic recognises not only the importance of the method of interpretation, but also the goal of interpretation, Jesus Christ (Luke 24:44–47; 1 Peter 1:10–12). While I cannot pursue this subject in more detail here, I refer interested readers to the article by McCartney (1988, pp.101–116).
4. Rendle-Short (1983, p.34): 'Principle 1: Consider the Context. The context is that of the God-given account of the origin of the world. In particular we are told that the world was created GOOD. It therefore makes no sense to understand Genesis as a parable of evolution, since evolutionary theory majors on cruelty and the death of millions of animals over long periods of time, including some of which were supposedly turning into humans.' (Emphasis in original).
5. Hence Davis A. Young's complaints about responses by Christians to his view about Genesis 1–11: 'Some people are eager to put me straight. I must not allow science to dictate my understanding of the Bible, they say. The Bible is the infallible Word of God, and Christians ought to take God at his word by accepting the clear and plain teaching of the Bible. I am also told that the Bible is its own interpreter. It should be allowed to speak for itself on its own terms regardless of what science says. It should be interpreted almost as if extrabiblical information did not exist.' (Young, 1995, p.x).
6. This subjective interpretation of Scripture is particularly dangerous in churches with a dictatorial leadership in which the 'revelation' received by the leader cannot be tested, such as in the so-called *Health and Wealth* teaching. See further: Johnson and van Vonderen, 1991, pp.70–71; McConnell, 1988, pp.103–115.
7. See further, Frame (1986, pp.213–236).
8. *E.g.* Rendle-Short (1983, p.35): 'Tyndale and the other reformers taught that the plain words of the Bible could be understood even by the unlearned. Interpretation by experts was not required. (Although in saying this we are in no way degrading sound scholarship). God, who is the Word, has not left us in darkness. Scripture can be understood even by babes (Matthew 11:25). *It is the 'clever' people who make difficulties.*' (Emphasis in original).
9. For an informative review see David J. Tyler's short article *Lessons From Paluxy.* (Biblical Creation Society, Rugby; *n.d.*).
10. One recent book that has picked up on this shortcoming is that by Forster and Marston (1989, pp.267–268).

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Noah's Ark comes to rest?

WE have reported various claims to have located Noah's Ark at a new location in Turkey, still in the Ararat range but 20km from the traditional site. Some of these 'researchers' have claimed to be creationists, but most creationist movements (*e.g. Biblical Creation Society*) have disassociated themselves from these people, pointing out fallacies in the proposed evidence.

Professor Ian Plimer, Head of Earth Sciences at the University of Melbourne, is strongly anti-creationist and he decided to take one of these ark-investigators to court. He charged that Allen Roberts was guilty under the Australian Trade Practices Act of distributing misleading and deceptive information. Professor Plimer put all his own financial resources into the prosecution, even selling his home to this end.

The case lasted a week during which the judge was critical of Plimer's action, indicating that he felt the case was misplaced. On the 2nd June, Justice Sackville rejected Plimer's complaint, leaving the geologist bankrupt. The case was lost on the basis that Roberts' activities did not constitute 'trade or commerce.'

On the other hand, Roberts did not emerge with credit either. The judge recognized that a number of his claims were false. Amongst these, Roberts was found guilty of falsely claiming to have conducted research identifying the natural geological formation as the Ark. Similarly rejected were his reports that he had found nails and animal hair from the Ark. Roberts also breached copyright law in publishing, without permission, a diagram by a former worker in the field, David Fasold. For this, he was fined A$2500. Fasold has previously attacked us for seeking to discredit his work, but he has now retracted his claims.

The Geological Column:

A Concept Foundational to Flood Geology

Steven J. Robinson

THE THEORY that the earth's rocks were formed during the Great Flood was first advanced by Thomas Burnet in 1681, at a time when geology was still establishing itself as a science. In 1695 John Woodward advanced the same idea with particular regard to the fossils, and suggested that the order in which rocks and fossils were laid down had to do with their specific gravity.

Although both authors attracted criticism, their theories commanded a large measure of acceptance until well into the next century (Young, 1995). However, as geological knowledge increased, and as the idea of a global cataclysm seemed less and less probable to natural philosophers, the Flood gradually diminished, until it occupied just the uppermost strata of the earth, and previous strata were explained by a series of earlier catastrophes.

At the same time geologists in Britain and Europe were beginning to classify rocks into the successive systems and subsystems which now make up the geological column (Hancock, 1977; Berry, 1987). Increasingly it seemed reasonable to impute long ages to these systems, and to understand the rocks as having formed gradually rather than episodically. Far from marking a sudden repudiation of the thoroughgoing diluvialism of Burnet and Woodward, Charles Lyell's proposal in the early 1830s that catastrophist presuppositions be replaced by uniformitarian ones culminated a drift from diluvialism that had begun three or four generations earlier, in the previous century. Once it became clear that the uppermost strata were remnants not of a Flood but of a prolonged Ice Age, Flood geology seemed to have nowhere to go.

Among Seventh Day Adventist churches in North America, George McCready Price (1923) revived the idea that the Flood could explain the whole fossil record[1], but only by rejecting the fundamentals of geochronology. He argued that the geological column classified rocks according to Darwinian preconceptions, regardless of actual position. While remnants of pre-Flood zoological provinces might have survived, the order in which they came to be buried, he maintained, was random. Another significant figure was Harold Clark, who taught Price's ideas to students for 25 years until one of them persuaded him to look at the disposition of rocks in the field for himself. Forced to recognise that the fossils were not randomly distributed, he explained them as reflecting the order in which the pre-Flood world was inundated (1946, 1977). Price and Clark were among those who, prior to publication, read through the geological chapters of *The Genesis Flood*, in which John Whitcomb and Henry Morris tacitly appropriated Clark's explanation. Now, in a recent article (1996), Morris has reiterated that view. Referring to the animals which perished in the Flood, he writes:

> '*Other things being equal*, they would be deposited in the same communities of organisms with which they had lived and roughly in the same relative elevations at which they had lived, even though transported considerable distances. Marine invertebrates would tend to be buried at low elevations, fishes at higher elevations, amphibians at the original interface between sea and land, reptiles a little higher, birds and mammals still higher. Marine sediments would be deep down in the column, land sediments at the top.'

Morris emphasises that this is an explanation of the 'local' column, since he rejects the geological column as a universal description of the record.

According to Morris, a creationist who does not reject the geological column cannot explain the order of the fossils, because to accept it means implicitly accepting the theory of evolution and abandoning creationism. Among other Americans teaching this view are Woodmorappe (1996) and Froede (1995). Froede (1996) calls for a complete re-evaluation of the stratigraphic column 'on both the regional and local scale,' believing that it is not only 'uniformitarian' but built on the premise of biological evolution.

If this view is correct, a geologist who believes in the Flood is obliged, as he seeks to make sense of the earth's strata, to retread the path taken by geology and start again, from where a wrong turn was taken in the 18th century. Creationist geology must be regarded as a separate science, still in its infancy (Froede, 1995). The stratigraphic record must be returned to its previous condition of non-intelligibility, to be interpreted afresh with the clear eyes of those who have biblical presuppositions. In effect, it becomes necessary to learn a new language, thereby cutting one off from the world which, ostensibly, one is seeking to persuade.

However, this assessment is not shared by workers on this side of the Atlantic (in Germany as well as in Britain). In their view, and as this article seeks to show, the geological column represents the evidence at a much lower level of interpretation, largely unencumbered by atheistic philosophy. In principle, the Flood may be discerned in the geological record without one's having to establish afresh what that record is. Flood geologists ought not to regard themselves as pioneers of a new science.

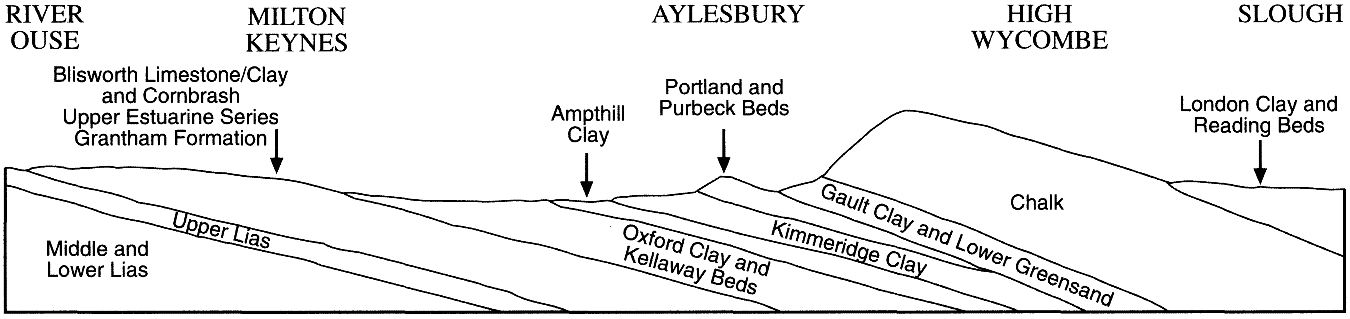
RIVER OUSE
MILTON KEYNES
AYLESBURY
HIGH WYCOMBE
SLOUGH
Blisworth Limestone/Clay and Cornbrash Upper Estuarine Series Grantham Formation
Ampthill Clay
Portland and Purbeck Beds
London Clay and Reading Beds
Chalk
Gault Clay and Lower Greensand
Kimmeridge Clay
Oxford Clay and Kellaway Beds
Upper Lias
Middle and Lower Lias

Figure 1: North-south geological section through Buckinghamshire (not to scale; vertical greatly exaggerated).

The alleged necessity of rejecting the geological column, distinct from its radiometric timescale, has not in fact been demonstrated. Indeed, since the 'local' order (allowing for the effects of overthrusting and reworking)[2] is only an incomplete reflection of the universal order, the attack on the geological column is a red herring: even in the local column marine invertebrates tend to make their first appearance before fishes, fishes before amphibians, amphibians before reptiles, and so on. As Morris himself recognises, an explanation for this order is still required.

The explanation offered is, in any case, not as obvious as it sounds. For what does it mean that marine invertebrates would tend to be buried at low elevations and fishes at higher elevations? If the bases of today's continents approximate to the land which was inundated, so that most of the fossil record overlies pre-Flood land, we would have to be talking chiefly about marine invertebrates being buried at low terrestrial elevations, where terrestrial animals also lived. But then why are marine invertebrates found at all levels of the fossil record? And why do terrestrial fossils, particularly in mid-continent, not precede marine fossils? The first tetrapods—appearing in substantial numbers from the Carboniferous onwards—supposedly mark the base of the pre-Flood world, yet no trace of such a world has ever been found. Plant and animal remains characteristic of the 'interface between sea and land' ought to mark the Flood's beginning, whereas in the fossil record they appear first several systems after the beginning.

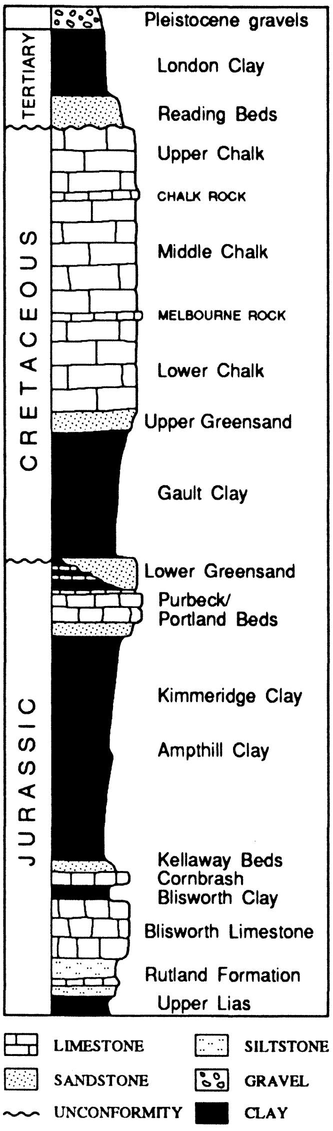

Figure 2: The stratigraphic succession in Buckinghamshire (simplified). Total thickness about 400 metres.

A sample local column

The 'local' geological column can be illustrated by reference to the geology of Buckinghamshire, where I live. Figure 1 shows a simplified north-south section from the River Ouse to the town of Slough. The beds dip towards the south-east, owing to uplift in the north-west of England and subsidence in the south-east after the beds were laid down. Massive erosion during and following that tilting cross-cut the beds to produce the present land surface. The lowest strata exposed along the section are those of the 'Upper Lias' and contain fossils typical of the Lower Jurassic; the uppermost beds exposed are those of the London Clay, assigned to the Tertiary, followed by thinly overlying Ice Age gravels.

Between the Reading Beds and the Chalk there is an unconformity: that is, an erosion surface and a corresponding break in the fossil (biostratigraphic) sequence, marking a period of non-deposition. An angular unconformity separates the Lower Greensand from the Purbeck Formation. Figure 2 shows the lithostratigraphy of the area as a vertical column.

Beneath the exposed beds, and proved by borehole evidence, lies a Palæozoic sequence of Carboniferous, Devonian, Silurian and Cambro-Ordovician rocks. Beneath these—beyond the deepest boreholes—lies the Precambrian basement. The Palæozoic sequence includes several unconformities, but the most striking unconformity is that above the Palæozoic, between Carboniferous and Jurassic, marked by a strongly eroded surface and the absence of Permian and (except in the far north) Triassic strata (Horton *et al.*, 1995). In places the hiatus extends down to the Ordovician. An unconformity may also exist between Palæozoic and Precambrian.

A biostratigraphic succession is evident. The Lower Palæozoic sediments are marine, contain marine invertebrate fossils, and seem to be devoid of terrestrial fossils. The Carboniferous rocks contain coals (seams of carbonised plant material). The Jurassic rocks also contain marine invertebrate fossils, often of a type found only in Jurassic strata, including various ammonite species in their characteristic sequence.

Some ammonite shells in the Oxford Clay were bored by molluscs and suffered heavy corrosion before being encrusted by other organisms; thus they must have lain on the seafloor for some time (Shephard-Thorn *et al.*,1994). Evidences of terrestrial life appear. *In situ* rootlets occur in the Upper Lias and in the Rutland Formation. A dinosaur track has been found in the Forest Marble Formation (just below the Cornbrash) and rare dinosaur bones in the Purbeck Formation and Blisworth Limestone. The Lower Greensand just north of Leighton Buzzard contains a high proportion of logs.

Any interpretation of this succession must also take into account the lithology and tectonic history of the rocks. The Cambro-Ordovician, consisting of mudstones up to 3 kilometres thick, were folded and uplifted along with the Silurian lavas and tuffs before deposition of the Devonian. Further uplift before, during and after deposition of the Upper Carboniferous left an above-water platform of Palæozoic rocks, known as the London Platform, which remained fairly stable until the end of the Jurassic and extended as far as Belgium. As elsewhere in England, the Lower Lias marks a major rise in sea-level, evidenced by progressively younger strata encroaching onto the platform and by the appearance of open-sea fauna, such as ammonites, which streamed in from the south. The Palæozoic rocks are predominantly grey. The uppermost levels, below the Mesozoic, are mottled with purplish, reddish and ochreous browns, attributed to subaerial weathering and oxidation during the Permian and Triassic.

The London Platform (shown in Figure 4a) stood above the sea through the Permian and most of the Mesozoic. During the early part of that period it suffered intense erosion, sufficient in places to lay bare strata down to Ordovician level. Overall, the Mesozoic strata show a progressive onlap onto the platform, interrupted by several phases of regression. Signs of emergence, such as shallow-water facies, root horizons and strata pinching out towards areas of non-deposition, accord with Buckinghamshire's position on the fluctuating margin of the platform. The angular unconformity between the Lower Greensand and the Purbeck (Figure 2) resulted from an episode of folding, followed by erosion, in late Jurassic to early Cretaceous time, attributable to plate-tectonic movements, including the opening of the North Atlantic. Early Tertiary uplift is responsible for the unconformity between the Reading Beds and the Upper Chalk.

Regional correlations

It is clear from Figure 1 that Buckinghamshire north to south embraces only part of the 'local' column. If one proceeded further north the beds exposed at the surface would become progressively older, until one reached the Palæozoic. However, distinctive stratigraphic sequences, coupled with lateral continuities in fossil content and mineral composition, also allow one to link up the geology of the area with that to the east.

Figure 3 illustrates the correlations made from Chipping Norton to Stamford, to define most of the 'Middle Jurassic.' Passing through the rocks which lie immediately north and west of Buckinghamshire, the section embraces some 80 miles (130 kms). At the base is the Upper Lias, a relatively uniform formation consisting chiefly of argillaceous sediments. The Lias Group thins as one approaches the London Platform. At the top of the sequence is the Cornbrash Formation, a grey, brashy limestone which weathers to an olive or brown colour. Between these distinctive horizons other regionally extensive formations can be correlated, including those whose lithofacies gradually change, for example from marl to sandy shale.

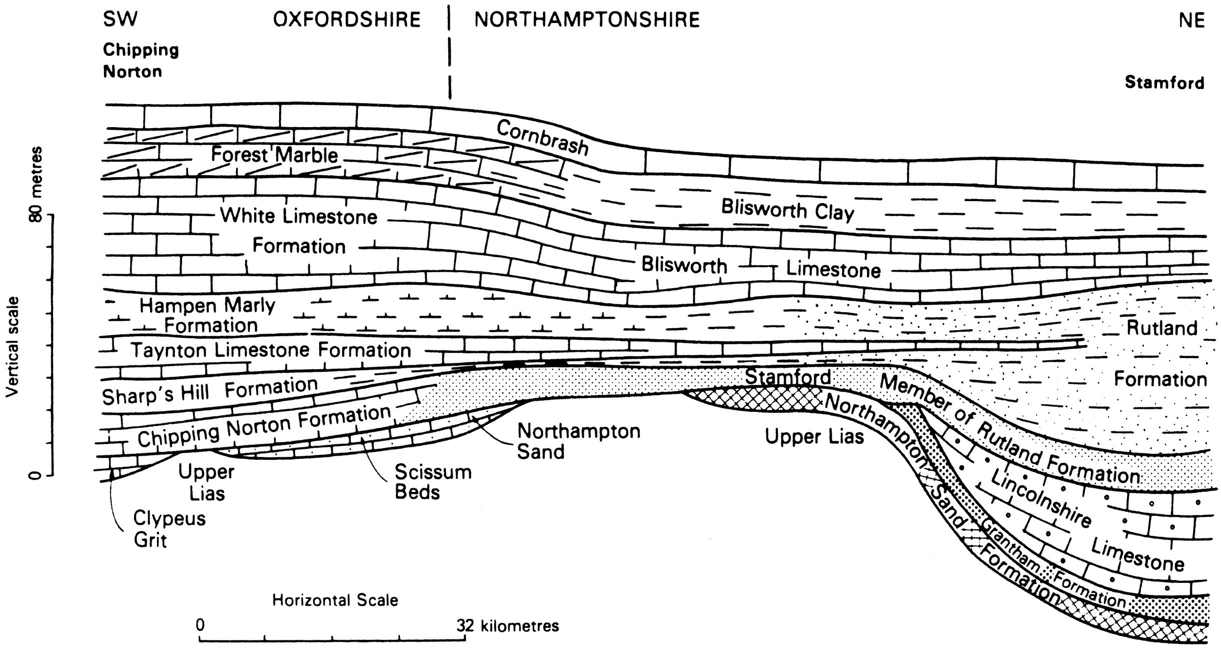

Figure 3: Rock formations with Middle Jurassic fauna correlated from Chipping Norton to Stamford (from Hallam 1992).

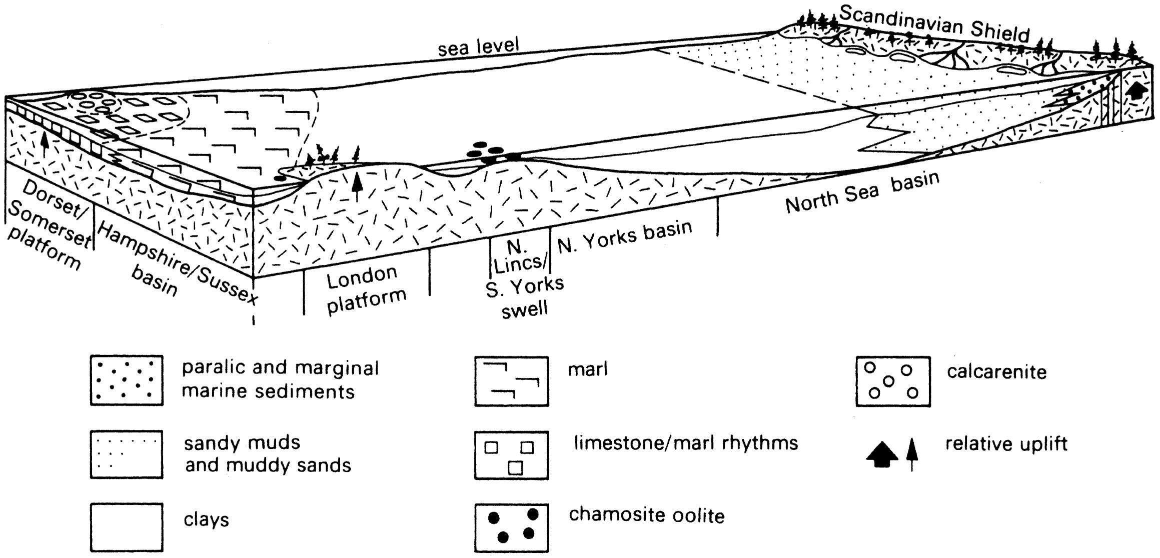

Figure 4a: Lower Jurassic lithofacies relationships in NW Europe (after Sellwood 1972).

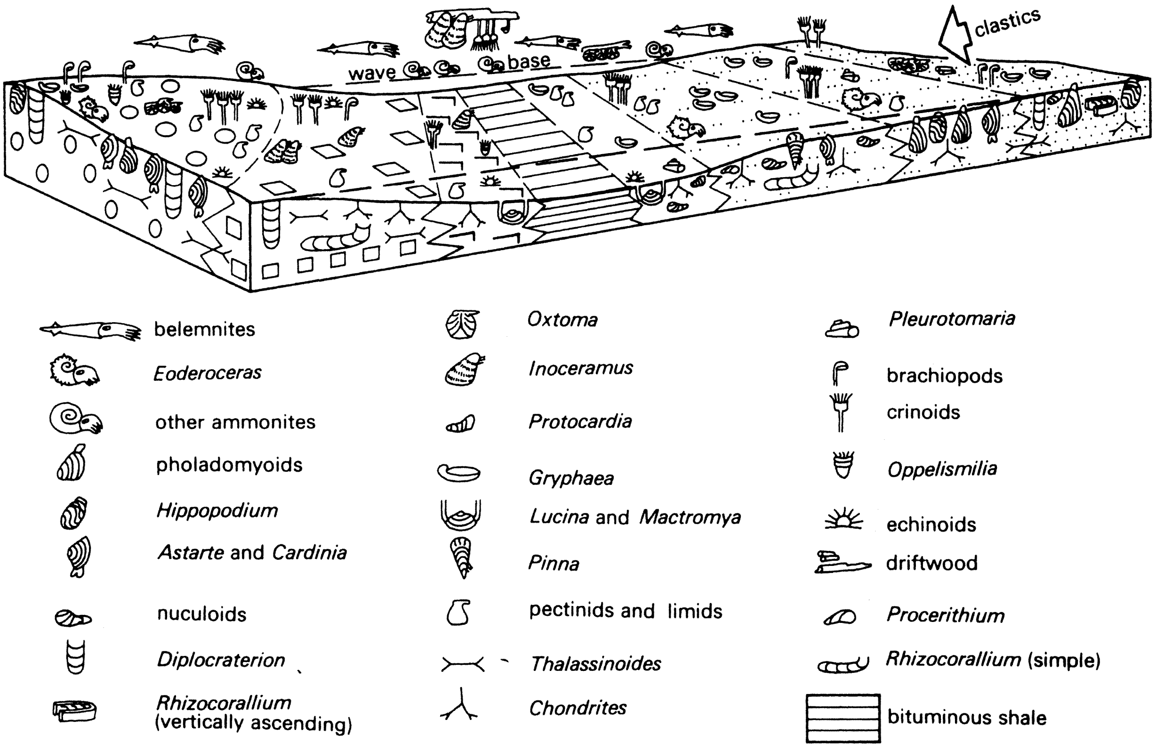

Figure 4b: Lower Jurassic biofacies relationships in NW Europe (after Sellwood 1972).

Such changes are interpretable as the effect of changing environments, as one draws nearer or further from the shore, or as global sea-level fluctuates, or as ground rises and falls because of regional tectonism (Sellwood and McKerrow, 1974; Sellwood and Jenkyns, 1975). Some correlations involving the less extensive formations are uncertain (*e.g.* Horton, 1977; Brandon *et al.*, 1990).

A correlation between two outcrops of the Cornbrash a hundred miles distant from each other does not mean that they formed at precisely the same time. Where (as is often the case) sedimentation is caused by the drainage of land areas, there will always be an element of progradation, so that time-lines run obliquely to stratigraphic boundaries. A similar point may be made where (as with the Cornbrash) the sediment source is marine. This can perhaps best be appreciated by reference to the Chalk: the lowermost chalk beds in Kent formed before those in the Chilterns, because the waters depositing the sediments were transgressing inland (Kennedy, 1970). Nonetheless the element of diachroneity should not be exaggerated, and

GLOSSARY

Ammonoid	Group of marine animals with whorled shells, including goniatites, ceratites and ammonites; the nearest living relatives would appear to be squids and octopuses (thought to have once had shells); visually, *Nautilus* is nearest.
Biostratigraphy	(Study of) stratigraphic distribution of fossils.
Craton	Precambrian continental land mass.
Diachronous	Cutting across a time boundary.
Facies	Outward character of a unit of rock, potentially including its fossils; lithofacies—that character exclusive of fossils, distinct from biofacies.
Homotaxis	Non-contemporaneity of similar-looking sequences in different areas.
Isochronous	Belonging to the same point in time.
Lithology	Nature and composition of a rock.
Lithostratigraphy	Stratigraphic analysis of rocks into horizontally traceable units.
Overthrusting	Thrusting of one rock unit over another in response to lateral compression of the earth's crust, so that the base of the displaced unit is older than the top of the other.
Palæontology	Study of ancient life.
Paralic	On landward side of coast, subject to marine incursions.
Phanerozoic	Literally, of the appearance of life, *i.e.* the period comprising Palæozoic, Mesozoic and Cenozoic.
Progradation	Sedimentation in a predominantly horizontal direction.
Reworking	Erosion and re-deposition of an older deposit.
Subaerial	Exposed to the atmosphere.
Tectonics	Large-scale structural behaviour of rocks in response to stress; plate tectonics is the theory that the relative position of the continents is continually changing as new seafloor forms from mid-oceanic ridges, and elsewhere old seafloor is swallowed up beneath continental plates.
Tetrapod	Amphibian or terrestrial animal with four feet.
Turbidite	Stratum formed as a turbulent body of waterborne sediment moves rapidly along a sloping bottom and releases its load.

must be understood in the context of the environments which make sense of the sedimentary features.

Correlations based on biostratigraphy—that is, on linking fossils (usually marine) which seem to occur within a narrow stratigraphic range—are not essentially different from lithological correlations, albeit that they ultimately depend on them. So long as one is identifying something distinctive, it may be just as reasonable to correlate two fossil assemblages as it may be to correlate two similar rock-types. Lithostratigraphy and biostratigraphy are interrelated aspects of a single record, and correlations tend to involve both aspects. Types of rock frequently express the type of environment in which, it is inferred, the animals flourished. Sea-lilies are typically found in limestones, for example; even some dinosaur tracks are specific to certain types of sediment (Lockley 1991, p.159).

Figure 4 gives a simplified cross-section of Lower Jurassic geology across England through to Scandinavia, based on inter-regional correlations. The picture built up from these correlations allows one to account for the changes in sedimentation and faunal composition in terms of differing environments. Similar correlations may be made for the rest of the Jurassic. The Cornbrash, for example, extends from Dorset as far as Yorkshire. No less extensive are the Oxford and Kimmeridge Clays (the main source of petroleum in the North Sea). The Blisworth Limestone may be part of a stratigraphic unit that extends from east Gloucestershire to south Humberside (Hallam, 1992).

The lithological correlations constitute the framework within which, across England and even larger areas, biostratigraphic correlations (not usually divorced from lithology) can safely be made. As William Smith, who pioneered the method, remarked:

> 'By the tables it will be seen which Fossils are peculiar to any Stratum, and which are repeated in others. ... My observations on this and other branches of the subject are entirely original, and unencumbered with theories, for I have none to support' (1817, pp.iv–vi).

Regardless of any explanation for the phenomenon, the method works, and inferences based on its assumptions have been repeatedly confirmed by boreholes.

In the case of Jurassic rocks the most useful chronological indicators are the ammonites, which serve to define chronostratigraphic zones. Hallam's explanation of the rationale behind their use is worth quoting (1975):

> 'When the same sequence of ammonite faunas is found over extensive parts of the world, as appears to be quite often the case at generic and even species level, we may assume with confidence that the defined zones correspond essentially to chronological divisions, for the following reason. If given ammonite genera or species originated in different areas at different times and also exhibited individual patterns of migration, at different speeds and directions, we should expect to find no consistent sequence in different areas. If a sequence of lower taxa *A...N* were found to occur in, say, different continents we should be forced to conclude, if chronological contemporaneity were to be denied, that the migration rates and direction for a whole succession of ammonites were identical over millions of years, which seems highly implausible. As the latter situation is generally the case, with the same sequence occurring in different areas of the same faunal province, homotaxis on a significant scale can be ruled out.'

This is a legitimate way of looking at the phenomenon, whether one is thinking of millions of years or decades. The successions, which are certainly real, are understood in the first instance to represent successive migrations into an area, rather than any evolutionary lineage. Far from suggesting evolutionary relationships with their immediate predecessors, the ammonites in British rocks have generally the appearance of an unrelated immigrant fauna (Bradley, 1972). The evolution which resulted in such a variety of forms appears to have taken place earlier and elsewhere. That being so, creationists may wish to argue that the proto-ammonoid ancestor was a genetically richer organism, rather than a more 'primitive' one.

Ammonoid biostratigraphy appears now to be well established. If, in the case of certain fossils, lithological and biostratigraphic data conflict, priority is given to the former, with the result that the stratigraphic range of the fossil, if appropriate, is extended (Rawson, 1992, p.375). As Smith noted, not all fossils have narrow ranges, and the strata containing them must be mapped before their ranges can be determined.

Global correlations[3]

One of the great confirmations of the theory that rocks attributed to the same system but lying on different continents are approximately coeval was the discovery that the continents were once joined together. The geology on the western coast of South America, for example, is very similar to that on the eastern coast of Africa, suggesting that the similar rocks were formed at the same time by the same events (or processes). By identifying the point at which the rocks become less similar, as well as by radiometric dating of the ocean-floor basalts nearest the two coasts, it is possible to be fairly precise about when, in geological time, the continents began to diverge.

In principle, lithological correlations ought to be on the soundest footing between rocks assigned to the Permo-Triassic, the period (if correlations allow one to identify such a period) when the continents were united, prior to Triassic rifting and post-Triassic continental separation. However, in terms of rock volume the Permian and Triassic systems are among the least well represented, and this is especially true along the margins of the Atlantic separating North America and Europe. They are also comparatively poor in fossils. On the other hand, evidence that South America, Antarctica, Africa and Australia were united during the Permo-Triassic is plentiful.

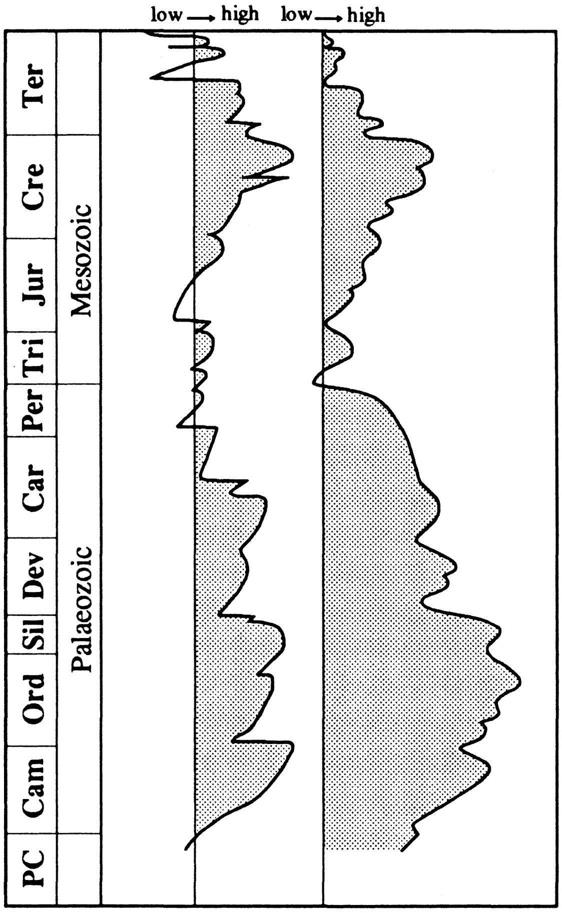

Figure 5: Global sea-level curves of Haq et al. (left) and Hallam (right), correlated with the biostratigraphic record. Vertical line shows present sea-level. The Precambrian may have been a time of cataclysmic non-marine inundation.

Extinction Events	Regression
late Eocene	?
end–Cretaceous	Yes
mid–Cretaceous (Cenomanian–Turonian)	–
end–Jurassic	Yes
early Jurassic (Toarcian)	–
end–Triassic	Yes
end–Permian	Yes
mid–Carboniferous (Visean–Namurian)	Yes
end–Devonian	Yes
late Devonian (Frasnian–Famennian)	Yes
end–Ordovician	Yes
end–Cambrian	Yes
end–lower Cambrian	Yes

Table 1. Correlations between mass extinctions of marine invertebrates in the fossil record and relative falls in sea-level as deduced from lithological and sedimentary changes (from Hallam 1989). Major extinctions in bold.

Generally, it is the consistency of the 'big picture' which gives one confidence that, say, Jurassic rocks on one continent were laid down about the same time as Jurassic rocks on another. Ager (1993) remarks upon how, at certain times in earth history, particular types of sedimentary environment were prevalent over vast areas—the quartzites at the base of Cambrian sequences, for example, the mid-Silurian limestones, or the Old Red Sandstone extending across northern Europe from Ireland to Russia. The Newark Supergroup of New York State and New Jersey (Triassic) is 'exactly like the Trias of northwest Europe.' Chalk rocks extend 'all the way from Antrim in Northern Ireland, via England and northern France, through the Low Countries, northern Germany and southern Scandinavia to Poland, Bulgaria and eventually to Georgia in the south of the Soviet Union.'

The similarities are not simply lithological. The approximate time-horizons which they imply (on the basis that the earth was passing non-cyclically through distinct climatic phases, as expressed by the rock-types) are confirmed by the matching patterns of tectonic and stratigraphic sequences. Close similarities in the sedimentology and geochemistry of the Cambrian successions of western Newfoundland, northwest Scotland and East Greenland suggest that the same conditions prevailed over a vast area (Swett and Smit, 1972). Mid-Palæozoic rocks on both sides of the North Atlantic reflect the development of mountain belts, such as the Appalachians and Scottish Highlands. Triassic rocks on both sides are characterised by rifting and the development of fault-controlled basins, prior to the continents themselves splitting apart. The marine transgression at the base of the Lias is attributable to a global rise in sea-level caused by seafloor spreading (Pitman and Talwani, 1972). Fluctuations in sea-level deducible from Upper Jurassic and Lower Cretaceous sequences in East Greenland and northwest Europe also suggest that these regions had a common history (Surlyk *et al.*, 1973).

Global sea-level curves (Figure 5), whether deduced from percentage areas of sedimentary cover (Hallam, 1984) or from facies changes on continental margins (Haq *et al.*, 1987), summarise the similar trends that can be discerned on a regional or inter-regional scale. They therefore give one confidence that the underlying relative chronology is sound. If the chronology did not approximate to reality, the repeated patterns of sea-level fluctuation making up the global pattern would not appear. Notwithstanding variations from continent to continent (Algeo and Seslavinsky, 1995), an overarching mega-cycle of transgression and regression through the Palæozoic and a second such mega-cycle in the Mesozoic and Cenozoic are discernible on all continents. Lesser cycles are also discernible. The coincidence of rapid falls in sea-level with major extinctions of marine fauna in the late Devonian, end-Permian, end-Triassic and end-Cretaceous, as well as with lesser extinction events at other junctures, tends further to corroborate the biostratigraphic correlations (Table 1).

The 'geological column'—that is, the raw data of the earth's rocks interpreted by geological investigation into some sort of order—is a synthesis of mutually independent successions, lithostratigraphic and biostratigraphic, that are mutually confirming. Its synthetic nature is its strength, not its weakness:

> 'By application of the principle of superposition, lithologic identification, unconformities, and reference to fossil successions, both the thick and the thin masses are correlated with other beds at other sites. Thus there is established in detail the stratigraphic succession for all the geologic ages.' (Engeln and Caster, 1952, p.417).

It allows one to trace the dynamic processes of rock formation: the development of a mountain belt, of a basin or group of basins, of a platform shelf. Such developments often have causes which require description and explanation on a continental, even global, scale. Sloss (1963) remarks on

> 'a fundamental homogeneity of the stratigraphy of the cratonic interior of North America. Individual major rock units can be traced over very wide areas; this permits the long-range time-stratigraphic correlation of these units on physical as well as biostratigraphic bases.'

Diluvialists should expect such large-scale continuities! To focus upon the local at the expense of the universal, as if one were arguing for a local Flood, is to adopt the wrong perspective. It is uniformitarian rather than diluvialist geologists who ought to be perturbed by the larger patterns and sheer intelligibility of the rock record.

I cite two further confirmations of the geological column: one drawn from the fossil *Halorella* (a biostratigraphic example) and one from certain anomalous concentrations of iridium (a lithostratigraphic example).

Halorella is a distinctive brachiopod that has been recorded on every continent except Antarctica. As Ager (1968) points out, it has no apparent ancestors or descendants in the fossil record, yet it turns up in places as far apart as Indonesia, Siberia, Turkey, New Zealand and Nevada—invariably in rocks identified on other grounds (for *Halorella* is not an index fossil) as Upper Triassic. If the geological column had no validity, so that 'the Jurassic in certain sections of Europe might correlate to the Cretaceous in North America, and to the Triassic in sections of South Africa' and so on (Froede, 1996), why should this brachiopod appear only in rocks designated Upper Triassic? Such examples might be multiplied many times over.

Fossil 'species'[4] often have very narrow stratigraphic ranges. The average range, in radiometric terms, is less than 10 million years, with most species spanning considerably shorter intervals; the range of genera rarely exceeds 20–30 million years (Raup, 1981). Although individuals of the same species may be separated by enormous geographic distances, the correlations which establish a narrow range do not have the effect of spreading other species over a much broader range. Species generally have narrow ranges *despite* the fact that those ranges are based on biostratigraphic correlations which must all be consistent with one another. Since the geological column is a vast network of such time-correlations, most relative dates may be supposed to have a resolution of the same order: accurate to within 1–10 million years, or one chronostratigraphic 'stage.'

Iridium is a metal rarely found in the earth's crust, but is a common constituent of meteorites. Concentrations of iridium discovered since 1980 at over 150 Cretaceous–Tertiary boundary sections from several continents have therefore been taken as compelling evidence for an asteroid impact at that time, and as a clue towards explaining the simultaneous extinction of the dinosaurs, ammonites and numerous other animal groups. But the discovery is also significant in confirming the reality of the Cretaceous–Tertiary boundary. Long before anyone was aware of the iridium abundance, the boundary in limestone formations was commonly marked by a thin clay layer and a simultaneous sudden decrease, or disappearance, of various types of plankton. Such features were themselves already highly distinctive. However, if there was any scope for doubting the world-wide synchroneity of these features

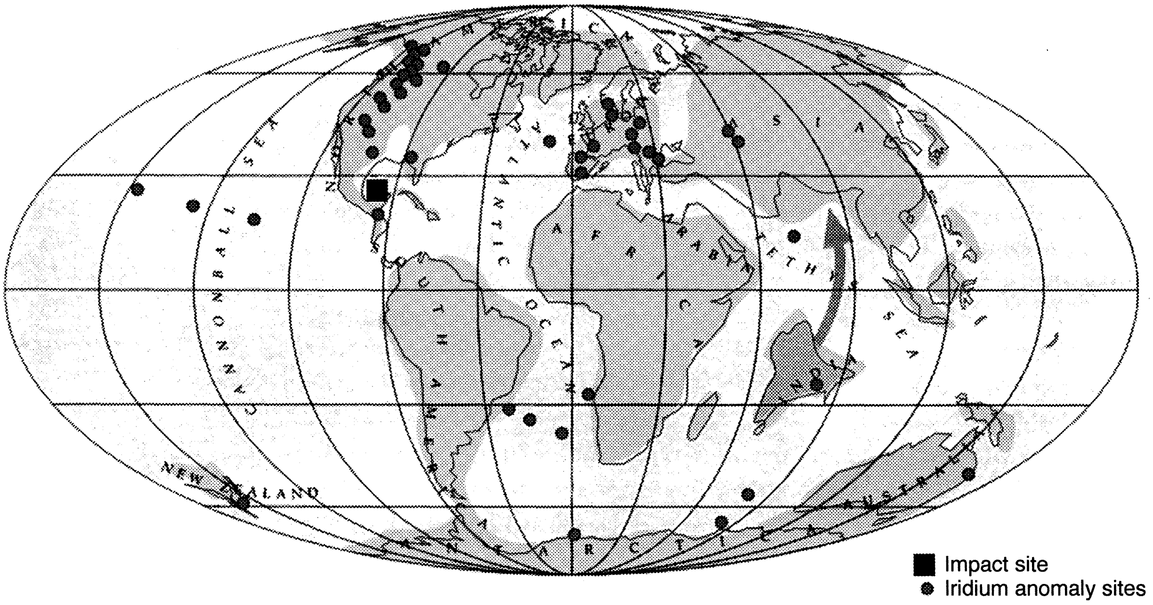

Figure 6: Inferred disposition of continents and seas at the end of the Cretaceous. The circles denote places showing an unusual abundance of iridium at the biostratigraphic boundary between Cretaceous and Tertiary, representing evidence of a large asteroid impact. The crater caused by the asteroid has been identified at Chicxulub, on the Yucatán Peninsula (black square).

(give or take a metre of sediment—in uniformitarian terms, about 100,000 years), the discovery of the iridium swept it away. Smit and Romein (1985) had to conclude that

> 'only a major impact with all its environmental consequences seems capable of explaining the lithological, trace element and biological evidence.'

The Cretaceous/Tertiary boundary was now linked to the global effects of an identifiable event. In 1990 details of an impact structure corroborating the theory were released by the oil company which had located it nine years earlier. Situated around the Yucatan peninsula of Mexico (Figure 6) and measuring some 180 kilometers in diameter, it was the biggest impact crater known. Radio-isotope dating of the structure yielded values concordant with an end-Cretaceous date (Sharpton *et al.*, 1992; Swisher *et al.*, 1992).

It does not follow from this that the correlations behind all other system boundaries in the geological column are as sound. Some may not be, and, depending on the strength of the evidence available, degrees of uncertainty are freely admitted (*e.g.* Smith, 1992). One need only acknowledge that where lithological and/or biostratigraphic correlations are made and there has arisen an opportunity to test them, they have usually proved close to the mark.

The arguments of Morris

Let us then examine the arguments which Morris advances for rejecting the geological column and implicitly ignoring the above considerations. How is it that he perceives the incomplete reflections of the fossil order in the 'local' geological column, but does not recognise that order when, by degrees, 'local' becomes 'regional,' and 'regional' becomes 'multi-regional'? Is it true that in his attempts to cast doubt on the larger-scale order, he employs 'half-truths and distortions,' as one critic alleges (Schafersman, 1983)? Consider the following statements:

1. *The geological column is an arbitrary construct because it is not fully represented in any local column.* (Morris, 1996)

We ought immediately to observe that the meaning of 'local' needs to be defined. Obviously a borehole core would represent a local column; but would, say, the comparatively uncomplicated geology of the Grand Canyon area? To limit the local column to the extent of a borehole would be unreasonable, since the core would contain insufficient data from which to construct a representative column—fossils, for one thing, are not that ubiquitous. At what point does it become illegitimate to widen the particular column?

In any case, the assertion that the geological column is not fully represented in any local column is open to question, especially if 'local' carries a wide meaning. All geological systems are represented in the Swiety Kryzys (Holy Cross) Mountains of south-central Poland, for example. Other such places include the Hebrides and North Minches basins in Great Britain, the Juixi basin in northwest China and the Williston Basin in North Dakota, among many others (Morton, 1995). So what is meant by 'fully represented': that every system be represented, or also every series and stage? The more demanding the requirement, the more unreasonable it becomes.

It is also far from clear what point prejudicial to uniformitarian geology is being made. The geological column is a generalisation based on lithological and biostratigraphic correlations—why is it therefore arbitrary? The incompleteness of the local column is due to the fact

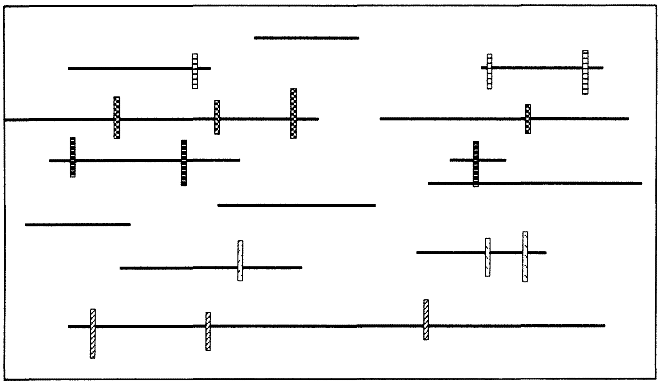

Figure 7: Schematic explanation of how rocks are correlated and thereby ordered into a relative chronology. The horizontal lines represent distinctive rock-units traced over distances which vary according to available outcrops, borehole soundings and actual extent. The vertical lines represent distinctive fossil assemblages which, in any one locality, are found to have a narrow stratigraphic range and, by extrapolation, are used to correlate discontinuous rock-units.

that sometimes rocks are being deposited, sometimes they are being eroded (and being deposited elsewhere), and sometimes neither, non-deposition becoming increasingly likely once a surface lies above water. Indeed, Morris (1996) thrice quotes geologists to emphasise that the sedimentary record is largely one of episodic events rather than of continuous sedimentation. This view, which is surely correct, is not inconsistent with the frequency of unconformities in 'local' columns.

2. *The dating of the rocks depends on the evolutionary sequence of the fossils, but the evolutionary interpretation of the fossils depends on the dating of the rocks.* (Morris, 1977)

This alleged exposure of circular reasoning is illusory. The first time the word 'dating' is used, it refers to the process of assigning rocks a position in the geological column; that is, a relative position, and hence (distinguishable from the radiometric scale applied to the column) a relative date. As explained above, this is not a process solely dependent on fossils. If it were, it would frequently come into collision with stratigraphic correlations which, where practicable, would also have to be taken into account. For example, palæontologists believe that no trilobites occur in the geological record after the Permian and no ichthyosaurs (types of marine reptile) before the Triassic, because trilobites always occur stratigraphically below ichthyosaurs. But if this belief were incorrect, being dictated solely by dogma, it would long ago have been disproved and abandoned. One would regularly be able to show that a trilobite-bearing Silurian stratum lay stratigraphically above an ichthyosaur-bearing Jurassic stratum. It would be possible to show this by stratigraphic mapping—whether on a local scale or on a regional scale. No one has.

Moreover, the theory of evolution, being a highly flexible theory, does not require that trilobites and ichthyosaurs belong to different 'ages.' The theory would be no weaker if ichthyosaurs were found in the Devonian, along with sharks. Palæontologists might then argue that ichthyosaurs were the ancestors of certain terrestrial reptiles: a somewhat more comfortable argument than that enforced by the present situation where—in contrast to the normal progression from sea to land—marine reptiles do not appear until after terrestrial reptiles. Within certain margins of error, the order of the fossils as given in the geological column simply describes the order that is observed, whether it suits the theory of evolution or not. As has been documented in both creationist and non-creationist works, the theory is not well supported by the fossil record. That Morris should suggest otherwise (1996, p.50) illustrates how his lack of knowledge in geology and palæontology leads him to promote false arguments for the Flood, and to ignore or undermine the most powerful ones.

Anyone who has studied the fossil record ought to know that it does not suggest a regular progression from simple to complex. Relatively simple forms occur throughout, as also at the present day, and relatively complex forms (*e.g.* trilobites) from almost the beginning.

The fossil record consists of a progression of overlapping smaller records (Figure 7), each one comprising the stratigraphic range of a taxonomic group, such as genus. The narrowest ranges occur at the species level; ranges become progressively greater as one considers larger groupings—genus, family, order and so on. Occasionally it is possible to trace evolution from one species to another within a genus (Figure 8), or from one genus to another within a family, such phenomena being consistent with modern research into basic kinds (Scherer, 1993). Despite their generally narrow range comparatively few species have value as index fossils, since the ideal index must also be abundant, geographically ubiquitous, and easily identified.

One of the most often used index fossils—graptolites—disappeared from the geological record in the Carboniferous; one species was recently found to be still extant (Dilly, 1993). Neither diluvialists nor evolutionists at present have convincing explanations for the way graptolite species and genera tend to appear in the same oft-repeated sequences (still with overlaps). However, this much is clear: they begin as graptolites, and they end as graptolites. Their usefulness as chronological indicators—particularly in determining a sequence of events within a regional setting (*e.g.* Finney *et al.*, 1996)—does not depend on there being a convincing explanation for their stratigraphic order.

The second time Morris uses the word 'dating' in the statement, it refers to the dating of rocks by radiometric means: an entirely different concept from biostratigraphy. Thus, while it is true that the theory of evolution depends on the long ages yielded by radiometric dating methods, it is not true to suggest that any circular reasoning is operating.

If we are to think clearly about the fossil record, this is an essential point to straighten out. According to Morris:

> 'The fossil evidence that life has evolved from simple to complex forms over the geological ages depends on

> the geological ages of the specific rocks in which these fossils are found. The rocks, however, are assigned geologic ages based on the fossil assemblages which they contain. The fossils, in turn, are arranged on the basis of their assumed evolutionary relationships. Thus the main evidence for evolution is based on the assumption of evolution.' (Morris, 1977).

In the first sentence 'geological ages' refers to the multimillion year periods produced by radiometric dating. In the second sentence 'geologic ages' refers to relative position within the biostratigraphic column, irrespective of radiometric dating. The third sentence is simply a false statement, and the fourth sentence accordingly a false inference. It is not mainstream geologists who are guilty of misrepresentation, but rather he who levels the charge.

3. *Somewhere the middle Ordovician grades unconformably into the upper Ordovician and somewhere the upper Ordovician grades into the lower Silurian, and so on.* (Morris, 1996)

Morris makes this theoretical claim in the course of developing an argument that the whole geological column was laid down continuously and rapidly. It had to have formed rapidly; indeed, some suggest rather the contrary because, he alleges, neo-catastrophists now recognise that 'every deposit has been formed very rapidly.' This breathtaking statement is undocumented and untrue. Not even Ager, who concluded that sedimentation in the past was 'often very rapid indeed and very spasmodic' (1993), expressed himself so absolutely. Some deposits do not, in fact, show unambiguous evidence that they formed rapidly. As for the former claim—the truism that sedimentation is always going on somewhere, just as sediments are always being eroded somewhere—this comes oddly from someone who considers it important to emphasise that the geological column is an artificial construct, because it does not exist complete in any one location. Is this not an argument admitting the rocks are, in principle, correlatable? If Morris does not accept that rocks were laid down in the order of the geological column, the references to middle Ordovician, upper Ordovician and so on are meaningless.

Morris documents the absence of world-wide unconformities, or time gaps, with the following quotation from the Chairman of the International Subcommission on Stratigraphic Classification:

> 'Bounding unconformities were the basis for establishing many of the earliest stratigraphic units recognized in western Europe. Many of the systems of the presently accepted Standard Global Chronostratigraphic Scale were originally unconformity-bounded units. This procedure has not been restricted, however, to the earliest days of stratigraphic work or to western Europe; it has been used, and continues to be used, in all parts of the world. Unconformity-bounded units became very popular at the time tectonic episodes were considered essentially synchronous world-wide, but did lose favour among geologists when synchroneity was found not to hold true' (Salvador, 1987).

It should be noticed, however, that this authoritative writer is also making an important point about how the systems of the geological column—the 'Standard Global Chronostratigraphic Scale'—originally came to be defined. They were defined by lithological criteria, namely unconformities, as much as by their characteristic fossils.

What the geological column does not entail

1. It does not entail acceptance of multi-million-year periods. Although the column is frequently illustrated with radiometric dates of this magnitude, radiometric dating is simply a means of calibrating the column; it is not integral to it. While the method may have limited value as another means of assigning a position within the column thus calibrated (Morton, 1982), its results are sometimes more erratic than its advocates would concede (Austin *et al.*, 1994).

2. A correlation based purely on biostratigraphic criteria—say, between strata on different continents—does not establish absolute synchroneity. Geologists assume that

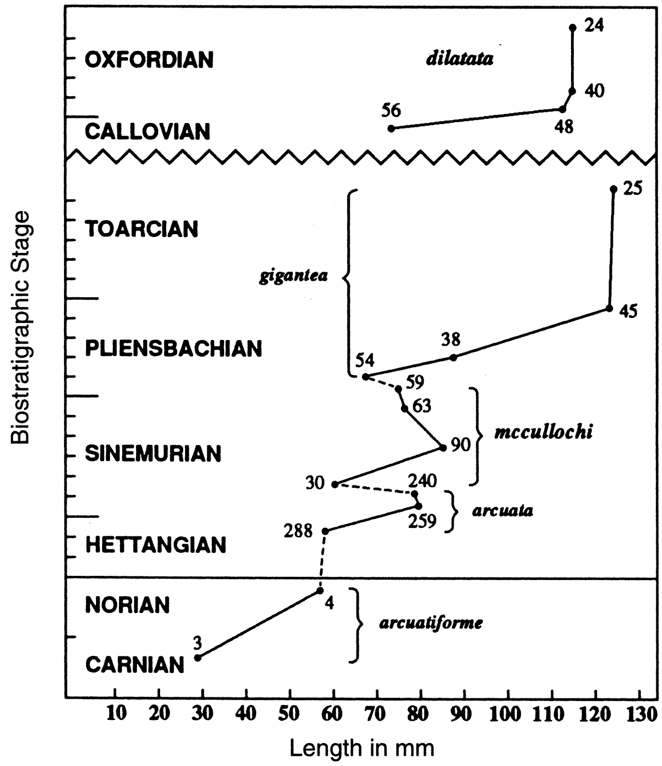

Figure 8: Maximum size of left valve attained by European Gryphæa *species plotted against time. Carnian and Norian are subdivisions of the Triassic, and Hettangian, etc.—identified according to ammonite zones—are subdivisions of the Jurassic, with the jagged line representing a hiatus of three such stages. Numbers indicate numbers of specimens. The analysis shows a trend of increasing length suggestive of variation within the genus.* G. dilatata *above the hiatus derived from another stock not shown on the graph. Looking at the* Gryphæa *record as a whole, Hallam (1982) was able to demonstrate a close connection between morphological (species) changes and environmental changes (e.g. transgressions, regressions, episodes of oxygen depletion).*

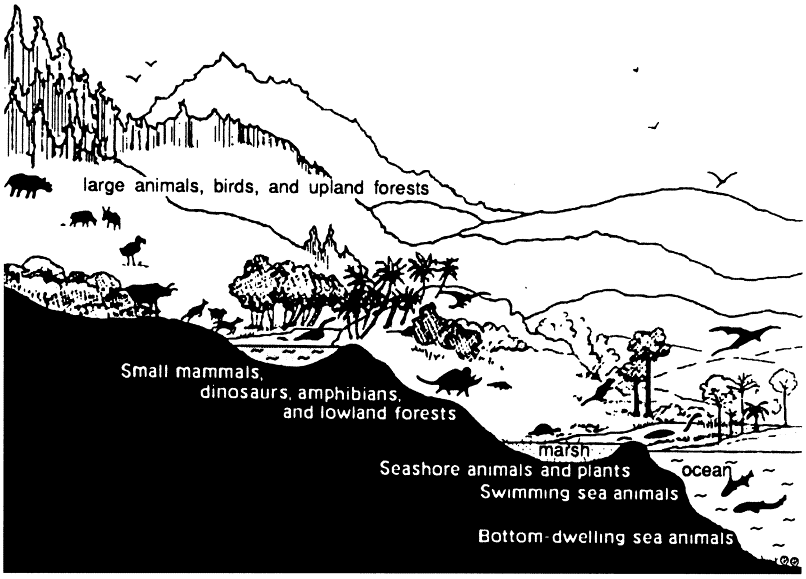
large animals, birds, and upland forests
Small mammals, dinosaurs, amphibians, and lowland forests
marsh
Seashore animals and plants
ocean
Swimming sea animals
Bottom-dwelling sea animals

Figure 9: An illustration of how, in the opinion of Whitcomb and Morris, animals could have been buried in a roughly predictable order by rising flood waters. The hypothesis has no basis in fact. For example, there is no worldwide unconformity beneath the first appearance of multicellular organisms which might correspond with a pre-Flood topography of lowlands and uplands. Also, although the most extensive marine deposits were laid down in the Early Palæozoic (see Figure 5), terrestrial animal fossils never occur in them, but occur stratigraphically above the earliest marine fossils. (From Coffin 1983)

the same type of fossil is diagnostic of the same stage in earth history wherever it is found partly because the narrow range of the fossil is understood to represent an evolutionary stage, as the organism passed from one form to another. Within a young-earth framework that may or may not be the best explanation; it is difficult to see how all occurrences of a particular graptolite species, for example, could be absolutely isochronous. However, in practice the more operative assumption is not evolution but simply that fossils of the same species in different localities are likely to represent a single contemporaneous population, bounded by climate, latitude and water depth in a faunal 'province' or 'realm.' They will lie, by and large, on the same stratigraphic horizon. This is primarily a biogeographical rather than an evolutionary concept, one that is not very different from the concept of successive ecological zones espoused by Clark and Morris. The biostratigraphic correlation of fossils is, in most cases, merely the identification of coherent faunal populations.

3. The geological column does not represent a systemisation of perfect synchronisms, whether biostratigraphic or lithostratigraphic. Isochronous horizons—*e.g.* volcanic ash falls, high concentrations of iridium—are the exception rather than the rule. Although purely vertical fall-out sometimes occurred, there was usually also a horizontal component. Indeed, certain modes of sedimentation, such as deltaic spreading or turbidite formation, were predominantly horizontal. Sediment must have a source, whether the process is gradual or catastrophic, and to bring, say, a body of sand from the place of erosion to the place of sedimentation requires lateral movement. This is well recognised in geology. Unconformities are also rarely isochronous, being usually associated with transgression or regression events that affect land surfaces progressively. The resultant unconformity may extend across several geological stages. Correlations, whether according to similarity of rock types, absence of rocks (unconformities) or biostratigraphy, are not necessarily equivalent to time-lines.

So far as the biblical account of the Flood is concerned, the only globally isochronous event was the eruption of the fountains of the deep all on the first day. The other stages of the Flood—the stopping of the fountains of the deep, the receding of the waters, the draining of the land—need not have been isochronous, since they were probably being described from an eye-witness perspective. This is equally apparent from a geological point of view. Because of the varying degrees of uplift and subsidence suffered by different parts of the earth, the waters are most unlikely to have drained from every area at the same time. With the Hebrew word *erets* meaning either 'land' or 'earth,' the phrase 'the waters were dried from off the earth' most naturally means that the waters had drained from the Ararat region—what Noah could affirm from his own knowledge—rather than that the earth everywhere had become dry. The Ark may providentially have landed in one of the first regions to become dry, seeing that there was every reason to quit the confines of the Ark as soon as possible. On a global scale the Flood waters could still have been receding.

Hence, while Flood geology must be able to demonstrate a match between the end of the Flood year and a significant unconformity in the Ararat region (if that region can be identified), a similar match between the biblical record and the geological column on every continent should not be looked for. The waters could have been 'prevailing' in some parts and receding in others, and since it may not be certain that, say, the Upper Silurian in one region is isochronous with the Upper Silurian in another region, on another continent, it is essential to keep in view the global picture, in which margins of error and regional variations tend to average out.

The 'geological column' is an aid to understanding, not an obstacle. Collations of data which present the global picture as it changes over time—such as sea-level curves, diagrams showing the patterns of fossil groups in the record, major extinction events, the incidence of continental flood basalts—are all made possible by the correlations which the geological column embodies, and all cry out for explanations which a global Flood is uniquely fitted to provide. The Flood cannot be effectively argued for geologically without the column. It is the common ground with old-earth geology—and the common language—which allows interpretations to be compared in meaningful dialogue.

The geological record reflects Flood and post-Flood environments, not pre-Flood ecological zones

It has never been difficult to argue the case that the geological record is largely a catastrophic record, and that, by comparison with the billions of years imposed on it by radiometric dating, its deposition was rapid. The principal challenge facing Flood geology today is not how to explain the character of the sediments, but how to explain the order of fossils (including the very narrow stratigraphic range of most fossils).

Morris, we have seen, has no satisfactory explanation. To suggest that marine invertebrates would tend to be buried at low elevations, fishes at higher elevations, amphibians at the original interface between sea and land, reptiles a little higher, birds and mammals still higher is to imagine that the original interface may be located half way up the 'local' Phanerozoic column when, logically, it must lie below the Cambrian. To claim that marine sediments would be expected to lie beneath land sediments is the reverse of the truth. If the Flood waters originated from the seas, marine sediments should lie on top of land sediments. (Compare Figure 9.)

At the last European Creationist Congress I examined eight predictions which Morris (1974, pp.118–20) made on the basis of his (or Clark's) Flood theory. Since Morris had not tested his own predictions, it was important to see whether they genuinely flowed from the theory and whether they were borne out. The predictions and a summary of the discussion are given below:

1. *Animals caught and buried would normally be buried with others living in the same region. In other words, fossil assemblages would tend to represent ecological communities of the pre-cataclysmic world.*

This could not be said to be a prediction of Morris's theory, because evolutionists would also expect fossil assemblages to represent ecological communities, whereas—in the case of assemblages deposited thousands of metres above the pre-Flood/Flood boundary—Morris ought to expect a confusion of communities.

2. *In general, animals living at the lowest elevations would tend to be buried at the lowest elevations, and so on, with elevations in the strata thus representing relative elevations of habitat or ecological zones.*

This is tantamount to arguing that dinosaurs were buried in the Jurassic because, before the Flood, they were living on a Jurassic surface. What, then, of the strata beneath the Jurassic (*e.g.* in Figures 1 and 4)? Are they, locally, not to be considered Flood deposits? In any case, fossils of upland animals are rare occurrences. One reason for this could be that upland animals live at a distance from the low places where sediments come to rest (Newell, 1959).

3. *Marine invertebrates would normally be found in the bottom rocks of any local geologic column, since they live on the sea bottom.*

Marine invertebrates (*e.g.* shellfish) are found in all systems. Those in the higher systems often lie thousands of metres above other rocks containing marine invertebrates. Such organisms are not infrequently preserved *in situ.* Figure 10 illustrates how hard- and soft-bodied burrowers colonised a succession of Liassic seafloors in northern Britain,

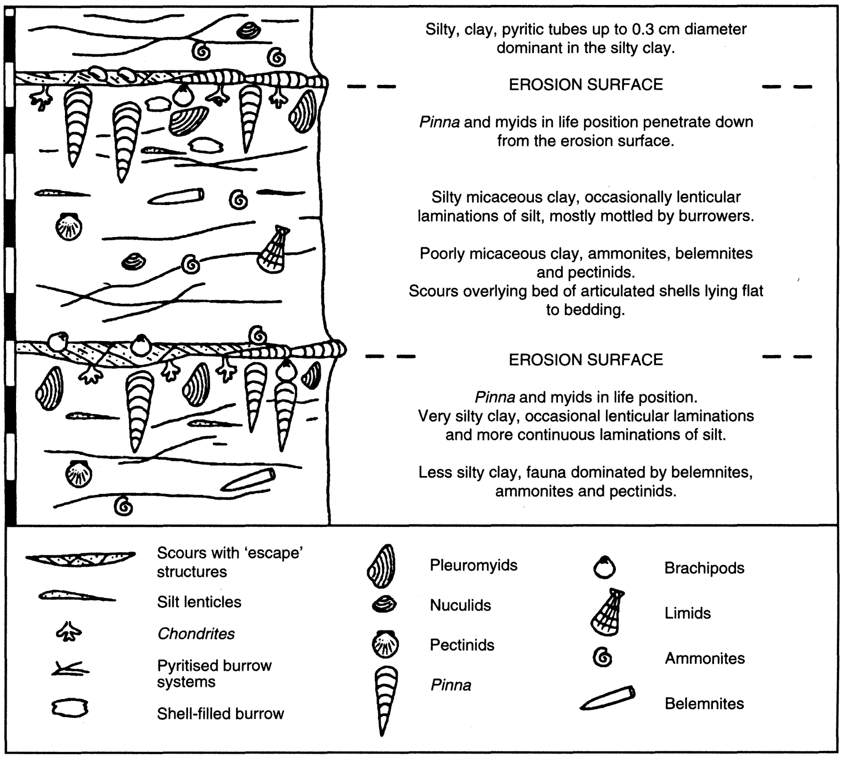
Silty, clay, pyritic tubes up to 0.3 cm diameter dominant in the silty clay.
EROSION SURFACE
Pinna and myids in life position penetrate down from the erosion surface.
Silty micaceous clay, occasionally lenticular laminations of silt, mostly mottled by burrowers.
Poorly micaceous clay, ammonites, belemnites and pectinids.
Scours overlying bed of articulated shells lying flat to bedding.
EROSION SURFACE
Pinna and myids in life position.
Very silty clay, occasional lenticular laminations and more continuous laminations of silt.
Less silty clay, fauna dominated by belemnites, ammonites and pectinids.
Scours with 'escape' structures
Silt lenticles
Chondrites
Pyritised burrow systems
Shell-filled burrow
Pleuromyids
Nuculids
Pectinids
Pinna
Brachipods
Limids
Ammonites
Belemnites

Figure 10: Schematic section through cyclical deposits in the Lias (Lower Jurassic) of Yorkshire and Mull, after Sellwood (1972). Scale bar = 1.65 m. Each stratum appears to have been the product of relatively low-energy sedimentation terminated by scouring. In the course of each cycle the currents gradually strengthened, but were moderate enough to allow fauna after each destruction to re-colonise the seabed. The suspension-feeding bivalves towards the top of the cycles grew in their find position, since Pinna*, once tipped over, cannot rebury itself. A few laminæ around the exhumed* Pinna *were encrusted by serpulids. Thus each stratum represents at least one generation—to be measured in months or years rather than hours—and constitutes a palæo-environment, albeit not necessarily a long-lasting one. In modern environments* Pinna *grows to a length of 20 cm in about a year (Butler & Brewster 1979); in Jurassic environments growth may have been more rapid.*

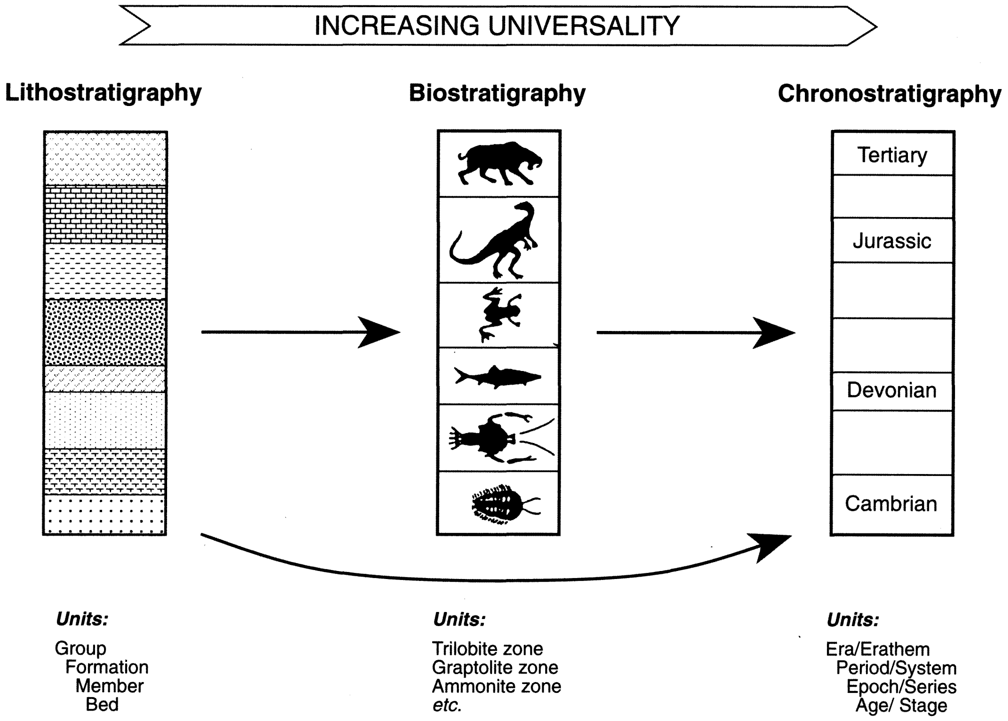

Figure 11: Lithostratigraphy determines biostratigraphy, and biostratigraphy determines chronostratigraphy. The resulting chronostratigraphic column may be tested lithostratigraphically, in turn, e.g. by tracing craton-wide unconformity-bounded cycles of transgression and regression, by tracing iridium abundance anomalies, by radiometric dating.

thousands of metres above other Phanerozoic rocks. How can one accommodate such phenomena within the single year of the Flood? Contrary to the impression given by Morris ('every deposit has been formed rapidly'), sedimentation here appears to be spasmodic rather than continuous, with each bedding plane marking a lull sufficient to permit colonisation. Indeed, fossiliferous horizons, including *in situ* fauna, are common enough in the geological record to indicate that spasmodic sedimentation is the norm rather than the exception.

4. *Marine vertebrates (fishes) would be found in higher rocks than the bottom-dwelling invertebrates. They live at higher elevations and also could escape burial longer.*

This prediction fails because, from at least the Devonian, both fishes and bottom-dwelling invertebrates are found in strata of all ages. Moreover, specific types of invertebrate—for example, *Halorella*—do not appear until after the first fishes.

5. *Amphibians and reptiles would tend to be found at still higher elevations, in the sediments at the interface between land and water.*

These animals are not found at 'higher elevations' relative to other topography at that stratigraphic horizon. They are merely found higher up in the geological column, and the prediction fails in the same way as the previous one fails.

6. *There would be few if any terrestrial sediments or land plants or animals in the lower strata of the column.*

This is true, but as already explained, Morris ought to have predicted the reverse: terrestrial sediments below marine sediments. Since the geological evidence shows that most, if not all, of the United States had been inundated by the end of the Ordovician (Sloss, 1988), the suggestion that terrestrial animals were not overcome until the higher strata is completely invalidated.

7. *Mammals and birds would be found in general at higher elevations than reptiles and amphibians, both because of their habitat and because of their greater mobility.*

This prediction fails in the same way as the previous one fails. It also calls into question whether the statement in Genesis that the Flood destroyed all terrestrial life, including birds, concurs with the fossil record. Birds and mammals do not occur at all in the Palæozoic and since they remain rare thereafter, one might suppose that many of them survived the Flood.

8. *Land animals would tend to be found segregated vertically in the column in order of size and complexity, because of the greater ability of the larger, more diversified animals to escape burial for longer periods of time.*

The order in which land animals are fossilised in the record bears no relationship to their size, complexity or apparent mobility. Many types of small animal and slow, ponderous animal do not appear until the Cenozoic.

It is evident that Morris made these after-the-event 'predictions' without either knowing or seeking to know whether the geological record would confirm them. In fact, they are either untrue or of no value, every one of them. Rejection of the geological column does not result in more acceptable explanations of the fossil order.

Nor can Morris's theory explain the pattern of increasing modernity through the record. The three basic divisions into Palæozoic (referring to 'ancient life'), Mesozoic (referring to 'intermediate life') and Cenozoic (referring to 'recent life') are a recognition of the fact that the proportion of modern-day genera with fossil representatives in the record increases over time. Nearly all amphibians, reptiles, mammal-like reptiles, mammals, birds and dinosaurs from the Late Palæozoic and Mesozoic had disappeared by the Cenozoic, and whereas in the Eocene only 3% of fossil 'species' have living representatives, in the Miocene this increases to 17%, in the Pliocene to over 50% (Eicher, 1976). Thus, if the animals which were spared from destruction left the Ark in the Pliocene, why did none of the terrestrial animals fossilised in the late Palæozoic to early Cenozoic apparently survive into the Quaternary? And conversely, why were almost none of the terrestrial animal kinds from the modern world fossilised in the Palæozoic and Mesozoic?

Conclusions

Morris argues for a global Flood but requires that creationists recognise only local columns. He describes a cataclysm of unimaginable power and fury but imagines human beings during the Flood 'running, swimming, climbing, floating on rafts, etc.—even though they would finally have drowned in the Flood waters' (Morris, 1996). He claims that in local columns the fossils reveal a pattern which the diluvialist would expect and even predict, but that in the geological column the fossils reveal an evolutionary sequence. As we have seen, these self-contradictory arguments show inadequate knowledge of the geological record.

The hypothesis that animals were buried in the order in which their pre-Flood habitats were inundated cannot be sustained. On the contrary, within and throughout the fossil record there exists a succession of destroyed or disrupted environments which—if one assumes a pre-Flood/Flood boundary lower than the Cambrian—must have formed after the Flood began. The distinctive lithofacies of those environments permit, over large areas, lithostratigraphic correlation; their short-lived faunas permit biostratigraphic correlation. In total those environments must have developed over a time far greater than that allowed by a scheme which ascribes the whole fossil record to the Flood. The task of creationist apologetics is to account for their existence within a framework measuring geological time in terms of months and generations; there is no obligation to squeeze them all into a single year. And if we are not to repeat the mistakes of history, we should consider the possibility that the Flood proper be identified with the lower, rather than higher, strata of the earth.

When *The Genesis Flood* was published, it came with the strong caveat that it was 'an exploratory sketch of a vast and complex field of study' and would 'necessarily be subject to extensive modification and amplification.' In practice, however, the legacy of *The Genesis Flood* and *Scientific Creationism* has been to sustain faith in the veracity of Genesis upon a basis of ignorance and credulity. The scientific procedure of testing hypotheses, of seeking out evidences which are problematic or potentially fatal, has never been followed, at least by Morris himself. Instead, 'predictions' have been made for rhetorical effect, beguiling the reader into thinking that the author has followed them through and been vindicated.

'Thus are engendered those fragile towers of hypotheses based on hypotheses, where fact and fiction intermingle in an inextricable confusion,' as someone wrote of modern Darwinism. Unless we overcome this legacy and admit our failures, which are as much moral as scientific, Flood geology will surely be consumed in the fire (I Cor 3:13). The Flood warns of the fire, but no one should suppose that the message of itself purifies the message-giver. If we aim to honour the Lord, it is vital that the arguments with which we commend his Word are well founded.

Notes

1. The term 'fossil record' in this article denotes the macrofossil record, from Eocambrian onwards, and thus excludes the algal and bacterial forms of the Precambrian.
2. See appended glossary of technical terms (page 30).
3. Here we touch upon a truly vast subject, and a vast body of literature. Two points may be emphasised: first, that stratigraphers are aware of the assumptions which must sometimes be made when correlating rocks and are always seeking to test them; second, that correlation on a global scale is an ongoing process, particularly in integrating the records of the less well researched continents. Much significant work is sponsored by the International Geological Correlation Programme under the auspices of the International Union of Geological Sciences, and reported in the periodical, *Geological Correlation*, published by UNESCO.
4. In palæontology a 'species' is perforce a morphological rather than biological term, and can be misleading. Jurassic ammonites, for example, 'have been oversplit by typologically-minded taxonomists, to the extent that widely recognised genera may often correspond more or less to broadly interpreted Linnæan species and the so-called species are no more than morphological variants' (Hallam 1975, p.214).

Graptolite Biostratigraphy

The graptolite fossils which are used for dating originated from planktonic animals—that is, animals which floated in the sea. They belong to the order Graptoloidea, and occur in rocks ranging from Ordovician to Lower Devonian (defined thus on the basis of other criteria). They are useful as indicators of relative age, or 'index fossils,' because they are widespread, abundant, easily identified, and usually occur in a vertical sequence of overlapping species, each of which appears only briefly. Somewhere between 180 and 230 genera are distinguished.

Although delicate, the hard parts of graptolites are often preserved intact. In that condition they do not suggest violent sedimentation. Consistently, graptolites are most abundant and at their most diverse in deep-water low-energy settings, such as basins, continental slopes, and shelf or platform margins. These are places where greater thicknesses of sediment were deposited but where, because of the greater depth of water, current strengths were weaker.

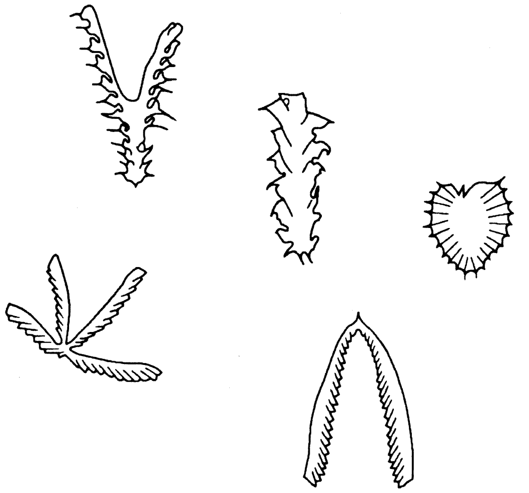

Figure 12:. A selection of graptolites

As explained by Berry (1987), graptolite biostratigraphy—and indeed biostratigraphy in general—involves the following steps (Figure 13):

1. Specimens are collected from many stratigraphic sections over a broad area.
2. Those sections are lithologically correlated, and the exact position of the specimens plotted on the composite section.
3. The specimens are classified according to species in order to determine the stratigraphic ranges of each species.
4. Certain 'congregations' of taxa are identified as restricted to certain intervals and thus as defining biostratigraphic 'zones.'

The resulting zones interpreted as chronological units are, of course, only as good as the sections sampled, and can be tested by performing the same exercise in a completely different area. When this is done, it sometimes happens that new species are identified, or that the stratigraphic range of a known species is extended.

Because most graptolites are found in rocks characteristic of deep water, they tend not to occur in association with shelly fauna. Similar biochronological sequences must therefore be worked out separately for other organisms, such as trilobites and brachiopods, and these then correlated with the graptolite sequences. Such correlations are at their most satisfactory where a rock sequence rich in one type of fossil can be traced into a rock sequence rich in another without lateral interruption.

Berry discerned three stages in the development of graptolite biostratigraphy. The first, beginning in the 1870s with the work of Linnarsson in Sweden and Lapworth in Britain, was the identification of graptolite zones, applying the method described above. The second, beginning in the 1930s, was the realisation that only certain areas and rock successions could be dated by the zones. And the third, the focus of interest since the late 1950s, is the attempt to identify evolutionary lineages and patterns of distribution which might suggest ecological niches. Obviously, the identification of evolutionary lineages cannot be attempted unless stratigraphic sequences are established first. Morris's idea that biostratigraphy depends on discerning an evolutionary sequence and that the sequence discerned is not stratigraphic but an artefact of arbitrary dating has no basis either in the history of biostratigraphy or in its modern-day practice.

The interpretation of the graptolite zones as chronological units is an inference based on the purely factual observation that species do not occur randomly throughout the sections but in a certain sequence. Such a sequence consists, most importantly, not of a medley of different organisms and different rock types, but of other graptolites within the same rock type. Certainly the fact that a particular species does not appear higher or lower than some other is generally assumed to be because, higher, it evolved into a different species (thereby becoming extinct) and, lower, it existed in the form of some ancestral species. But that is

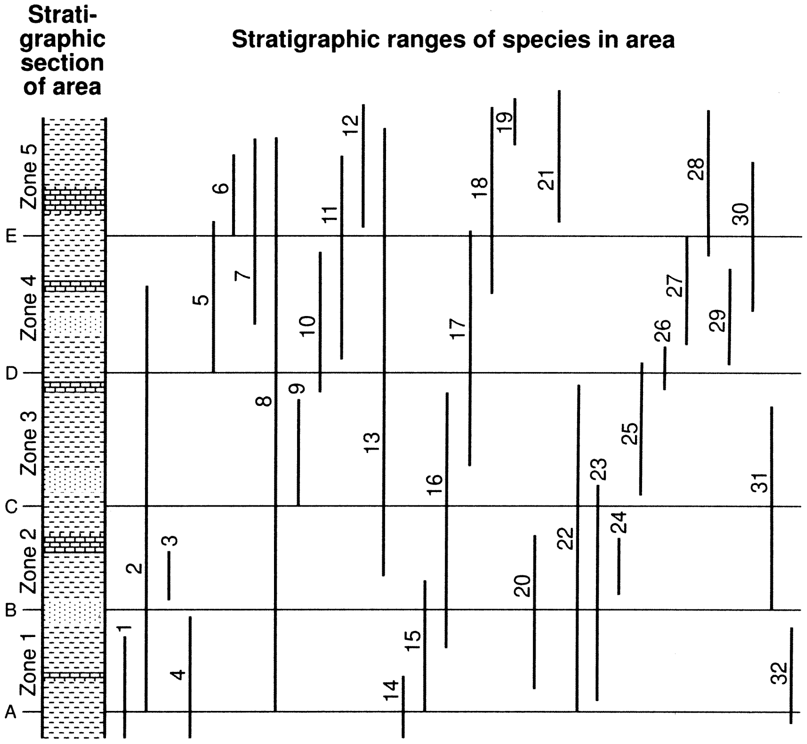

Figure 13: Diagram illustrating the principle of biostratigraphic zonation. Stratigraphic sections over a broad area are correlated by lithology and bedding to produce a generalised stratigraphic column. Stratigraphic ranges of the taxa (e.g. species of graptolite or ammonite) that have been collected from the area are then plotted against the section. Zone boundaries are drawn by reference to first and last occurrences, to enclose so far as possible taxa whose range is the most restricted. Boundary B, for example, is where species 3, 24 and 31 make their first appearance and species 1, 4 and 32 their last. The concurrence of species 3, 15, 20, 24 and 31 is unique to the rocks designated Zone 2 and provisionally, therefore, defines that zone in time.

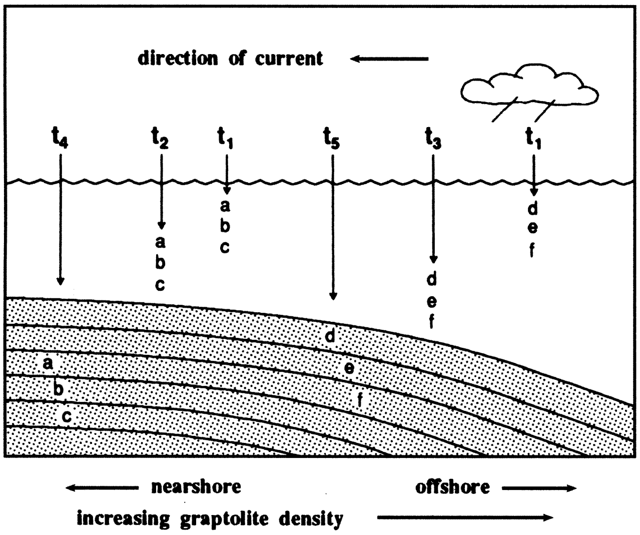

Figure 14: Model of how different graptolite species (a–f) might be deposited in a certain vertical sequence, according to their preferred depth in the water when alive and the depth of the water column itself. Time t_2 is later than time t_1, and so on.

an interpretation distinguishable from the observations, and often another interpretation may be preferable. After all, if the graptolite sequences are evidence of evolution (in the neo-Darwinian sense), why do most genera appear suddenly, and with minor variation retain their distinctive form from inception to extinction? (The theory of punctuated equilibrium is unconvincing here, where there is no change in environment or apparent isolation of a population.) Why is it often difficult to identify evolutionary lineages from one genera to another? And why—most crucially of all—do graptolites as an order, indeed class, appear to have no ancestor?

Nonetheless, some evolution—in the sense of considerable variation in size and form within a graptolite gene-pool, and not necessarily as a result of natural selection—almost certainly occurred, perhaps during and after the Flood as well as before it. It is possible that far fewer types of graptolite were created on Day 5 of Creation than those preserved in the fossil record, that a capacity for extraordinary variation was inbuilt in the organisms, and that certain 'phenotypes' were triggered by environmental stress. Indeed, there exists a preserved specimen, half of which, because of some aberration, developed in the form of one 'genus' and half in the form of another (Fortey and Bell, 1987)! Some workers have suggested that with certain species the same genotype regularly expressed itself in two or more forms (Rickards, 1977). One need not postulate genetic mutations in order to account for morphological variation.

A comprehensive diluvialist explanation of graptolite sequences has yet to be worked out, but it is likely to involve a number of factors, including (1) differences in the depths at which various species floated, (2) environmental changes affecting graptolite colonisation, (3) migrations of different species into a region as a result of changes in relative sea-levels and prevailing current directions, (4) morphological variation after the Flood began and (5) morphological variation before the Flood. Much relevant research into some of these factors has already been done within an old-earth framework.

A preliminary and tentative explanation which incorporates some of these factors is offered in Figure 14. The interested reader may like to consider the model in the light of the paper by Watkins and Berry (1977).

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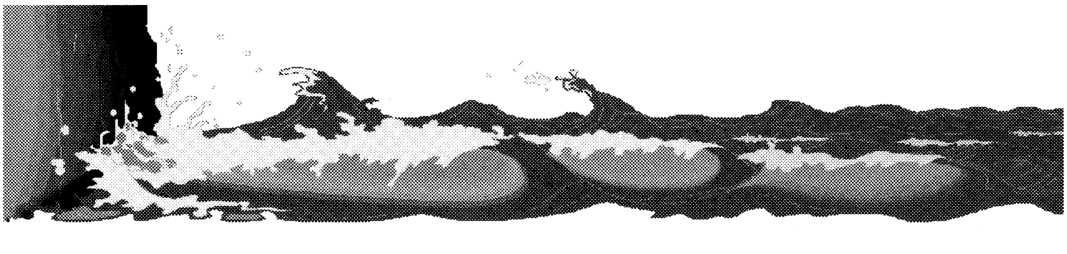


Queries and Comments

q: How do you explain the differences in the accounts of the Creation in Genesis chapters 1 and 2 which apparently contradict each other?

a: I am pleased that you recognize that the problem is in our perception rather than the accuracy of Scripture itself. This is always half way to solving the problem.

The difference is in the general focus of the two chapters. Too many people take these chapters in isolation from the rest of the book. It is clear from the New Testament, that the whole book (and the following four books) was written by Moses. (This does not exclude the possibility that he used some prior sources and edited them into a unified book. Nor does it exclude the fact that the whole is inspired by the Holy Spirit who guided Moses so that what he wrote is accurate in detail as well as in principle).

Throughout the book, we see that there is an initial overview followed by a more focussed record. For example, we see the history of Noah's family in general before Moses focuses in on Shem and his descendants. The focus is always on the chosen line.

Applying this guideline here, we see that chapter one is concerned with the whole creation, climaxing in man; chapter two is concerned with man and the rest of creation is in the background. Chapter one is about the origin of the heavens and the earth; chapter two is about what they themselves produced. Because of this, chapter one tells us that God made male and female in His own image; chapter two gives us more detail: how man and woman were made at separate times (on the same day) but by different means. It also tells us why we have two sexes. There is no contradiction.

That chapter one is chronological must be without doubt. We see clear sequential acts, divided by specific time frames. This is not the case in chapter two. You can check this out very simply by looking at the text. 2:8 tells us that God put man in the garden. He did various things, then (2:15) He put man in the garden! In chapter two, *purpose* is the emphasis, not chronology. It is complementary, not contradictory.

So, let us examine the earlier part of the chapter. Verse 5 tells us that there is no garden for man at this point in time. There is no garden because there is no rainfall to water it and no man to till it (*cf.* 2:15). This could mean, as some claim, that the special garden in Eden (2:8) did not exist and the rest of the earth was wild or it might refer to the state of the earth at the end of the formation of dry land in day 3 of Creation.

How then do we understand verses 4–6? This is perhaps best expressed by a paraphrase. 'When the Lord God created the earth and the heavens, there was at this time no field shrub in the earth and nor any field plants, since, as yet, the Lord God had not established rainfall on the earth and there was no man to cultivate the ground. But there then arose waters from under the earth which watered the face of the whole ground and the Lord God formed man ...'

Similarly, verse 19 does not imply a sequential event (man followed by the animals). The *NIV* translation fairly renders it as, 'Now the Lord God had formed ... all the beasts of the field and the all the birds of the air ...' The context again is plain. God made man (2:7) and then He brought to that man the animals that He had also created (2:19) for that man to name them.

I believe that you will find all this is consistent with the text of Genesis chapter two and demonstrates a harmony with chapter one.

q: How did Adam manage to name all the animals during the sixth day?

a: This question is closely related to our previous one and is easily solved when we look carefully at what is actually recorded.

During the sixth day, God created land animals and the man. He brought the animals to man for naming, so demonstrating to man that his lordship over the creation left him without someone with whom he could share his life. So, God created his wife.

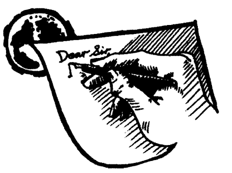
Specifically, we are told that God brought to him 'livestock, the birds of the air and all the beasts of the field' *(NIV)*. Comparison with chapter one, shows that this excludes the sea creatures and the creeping things. (So, we are not considering the thousands of reptiles and amphibians). We do not know how many (for example) dogs God created, but it is reasonable to understand the passage to indicate that *a* dog was brought to Adam for him to name the *kind* (to choose the classification system of chapter one). The same would apply to other categories of creature.

So, for example, when we look at the 'livestock' ('cattle' in the *KJV*), we are looking at the domesticated livestock. Modern cattle almost certainly come from the same kind as the buffalo, bison, *etc.* On that basis, we are looking at a few score of animals at the most.

Moving on to the birds, we are not concerned with the eight thousand or more species that the modern ornithologist lists. For example, there are nearly three hundred pigeons, but Adam probably only gave the distinctive name to *a* pigeon as typical of the variety that would develop over time. One cuckoo would be named, rather than the 127 recognized today. One parrot would probably represent the three hundred that we can classify today under that general heading. (In fact, even today the non-specialist would tend to put all pigeons in one category, and so on). On this basis, we are looking at a little over 150 families of birds.

Many commentators have noticed the subtle distinction between the 'beasts of the earth' (1:24) and the 'beasts of the field' (2:19). They would agree that the former is more comprehensive than the latter and would include what we would now call 'wild animals.' (This translation in the *NIV* for 1:24 is not really appropriate except in a post-Fall view of wildness!). In chapter two we are looking at those animals which have a close cohabitation with man. Undoubtedly these would be a few hundred at the most.

So, in that day, Adam would have named no more than five hundred creatures. That could be done in a few hours (remembering that God brought these animals to him, 2:19). Obviously Adam would have named the other creatures in subsequent days as he encountered them. There is, therefore, no problem in accommodating this naming process in day 6 of the Creation week.



Correspondence

THE SERIES of articles on *The Bible and Chronology* has generated quite a bit of correspondence and, with the final part in *Origins* 22, this is a good time to respond to it. It is worth noting that the general tone of the correspondence has been constructive and supportive of the basic thesis that the biblical record is trustworthy.

As noted in the series, there are legitimate areas of doubt, both in the biblical and secular research. We have seen that the biblical data indicates that the Flood must have been around 5,000 years ago and Creation up to 7,000 years ago provided certain assumptions are made, especially with respect to the completeness, or otherwise, of the genealogies. We have also seen that the preferred synchronism for the Exodus and entry into Canaan is at the end of the Middle Bronze Age. We have also noted the difficulty in relating the biblical chronology to radiometric measurements since these are based on invalid assumptions.

Mr. Peter Vallis *(Pontypool)* sent in some interesting correspondence in *Time* magazine in which they were examining the relationship of biblical data to archæology around the same time as our article was published. The interesting point arising is the different presumptions we have. For them, human interpretation of the data is used to judge the Scripture; we seek to understand the data in the light of God's reliable revelation.

Mike Viccary *(Berwick on Tweed)* questions my use of the 430 years for the period of the exile in Egypt, pointing out that he believes that this period of time (Exodus 12:40; Galatians 3:16–17) refers to the time from the giving of the promise to Abraham (Genesis 12:17) to the Exodus. This is a possible interpretation, and, on the surface, the most natural one. It is reinforced by the Septuagint wording of the Exodus passage as '... in Egypt and Canaan.' David Rohl, in his recent historical reconstruction *(The Test of Time)* uses this reference to conjecture an archæological identity of Joseph. The period of time from Abram leaving Haran to the descent into Egypt would be 215 years, leaving 215 years for the sojourn itself.

While all this is attractive, and fits with the recorded family tree of Moses and the 'fourth generation' reference of Joseph, it is not unambiguous, as I showed in the articles. In particular, if we compare the genealogies, we do have problems: while Moses is the fourth generation from Jacob, Bezaleel is the seventh, Elishama (Numbers 1:10) is the ninth and Joshua is the eleventh. Taking into account the difference in ages between Moses and Joshua, we would expect a difference in generations, but not by that amount. The family size at the Exodus is also consistent with the longer period of time. So, while I would not rule out Mr. Viccary's suggestion that the exile was for 215 years (rather than 430), I am still inclined on the balance of the data to stay with my figure. Reference to the charts that I drew shows how *all* the evidence is consistent when this interpretation is used.

Graham Wilson *(East Lothian)* and **Charles Nicholson** *(Edinburgh)* both picked up on the issue of the possible gaps in the generations. In particular, they pointed out that there is a sudden drop in the ages between Eber and Peleg (in contrast to the otherwise smooth adjustment). They suggest that there could be missing generations at this point. With this I would agree, but we should note that there could be an alternative explanation for this adjustment: a further time of environmental change (the displacement of the continental masses) which affected the lifespans. (**Dr. Richard H. Johnstone** has submitted a paper for consideration on this matter). Both writers mentioned the need (with which I whole-heartedly agree) for us to avoid being locked into fallible human interpretations of Scripture when it does not, of itself, require particular interpretations. Indeed, in my paper I drew attention to the possibility of missing generations (as in the example of Moses above and the New Testament genealogies of our Lord Jesus).

Both these writers pointed out that Egyptologists require that the history of Egypt would need to go back to 5000 BC anyway. Mr. Nicholson adds that we need to insert between the Flood and Abraham several events: the development of the nations, including the Babel event, and the establishment of Egypt (which had clearly happened by the time Abraham arrived there).

Steven Robinson *(Aylesbury)* amplifies this point further and very lucidly. We need to include in this time:

the successive geological Mesozoic and Cenozoic eras;
the human generations represented by the Old, Middle and New Stone Ages;

the early dynasties of Egypt (through to the sixth).

The choice of the Sixth Dynasty as the limit comes from other evidence. The destruction of Sodom and Gomorrah was, we agree, in the Early Bronze Age III. This equates with the Sixth Dynasty. Various assumptions are included here. For example, that the Flood ended sometime in the Palæozoic. With this I agree. It also implies that the early dynasties were successive. This is probably also true, though he and I would agree that there is a possibility of some parallel dynasties in the Old Kingdom. As indicated in my paper, Steven is hoping to publish a more detailed reconstruction of this information elsewhere and I would urge readers to take note of it.

Mr. Robinson also points out (in the paper alluded to above) that there are several other constraints to be taken into account. For example, the Ice Age chronostratigraphically precedes Egypt's Predynastic history, yet Abraham was there in the Sixth Dynasty. So, we have to allow for the period of the Ice Age (about 500 years according to Michael Oard) and the recovery time. Since human remains outside the Mesopotamian region occur in Palæolithic times, these must date to the post-Babel period. This puts a minimum time constraint on the data. All these points need thorough research so that we may know how to relate them to the Scriptural record.

Clearly there is a need to consider the possibility of missing generations if these data are to be taken seriously. Alternatively, you could reject the concept of the Flood ending in the Palæozoic, but please consider Steven's article on the Geological Column in this issue.

Peter Williams *(Cambridge)* picks me up on a possible inconsistency! I referred to the presence of Cainan in the LXX and Lucian genealogies and indicated that we might need to add a further 130 years to the Hebrew genealogical table. As Mr. Williams correctly points out, the LXX consistently adds an extra hundred years to the Hebrew ages of the fathers (at the time of the birth of their sons), so I should add 30 years, rather than 130 years to the Hebrew table to compensate for this. That would be more consistent and I agree to that correction. That article (*Origins* 7:19) requires two further amendments. In figure 3 (page 8), Daniel's exile was in 605 BC, at the time of the first deportation from Jerusalem, not 597 BC (which is when Ezekiel was exiled). Further, the last sentence of note 13 (page 11) should be deleted.

We quoted **Dr. Glen Zweck** in a previous issue (7:19, page 4). He makes some valuable points, several of which are open to individual interpretation, but are well worth noting in response to this subject. He also picks up on the issue of the sharp drop in the ages, as mentioned above, which we accept is a possible example of missing generations.

Dr. Zweck's comments on Wiseman's colophons 'These are the generations of ...' is quite correct. Professor Wiseman interpreted these statements as referring to written records and being the closing statements of each. It is equally acceptable—and possibly more reasonable—to see these as preambles, referring to the generations or histories arising from the named person, i.e. 'That which came forth from ...' I am increasingly favouring this understanding of the phrase myself. (Obviously it makes no difference to the basic argument of the article). Dr. Zweck's warning about reading too much into Biran's claims about the reference to 'the house of David' at Tell Dan was in order, but, I think, subsequent papers overall do back Biran's claim.

Finally, I would like to refer back to the last paper on geochronology. A interesting paper was published by G. Herbert Gill in Creation Research Society Quarterly (*A Sufficient Reason for False Rb-Sr Isochrons*, 1996, 33:105–108). He points out that there is a fundamental flaw in the use of 'Simple Linear Regression Lines' as a statistical interpretation of the radiometric data. This process is invalid if two or more independent variables affect a single dependent variable. He shows that such a relationship is used in many of these isochron determinations. In a letter to *BCS*, **Lloyd To** points out that such data would be invalid anyway if the earth is only a few thousand years old. This is a point made in the last part of my series. Generally, I showed, we cannot measure, with any degree of confidence, differences in activity corresponding to a period of time greater than ten half-lives. Expressed in another way (derived from the equations given), the ratio of daughter product to parent isotope would have to be greater than 0·001. Lubenow reports that the sensitivity in potassium/argon dating has increased, so we are looking at a ratio of 0·0001 now. (Remember, though, that we saw there are substantial doubts that can be raised about this system even being applicable to dating processes). If we accept this greater precision, the technique is invalid for dating anything less than 0·2 million years (K/Ar), 7·25 million years (Rb/Sr), *etc.* So, we cannot expect any correlation between biblical data and radiometric data on the basis of an age interpretation. As we said, we need to find a more valid interpretation of the data.

By way of summary, this correspondence indicates that, even with a high view of the inerrancy of Scripture, there is room for doubt on precise dates. This does not leave room for massive extrapolations to fit in with the evolutionary timescales, of course! It also means that we have a healthy scepticism of Ussher's well-intentioned calculations. My thanks to all those who wrote in.

J.H.J.P.

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